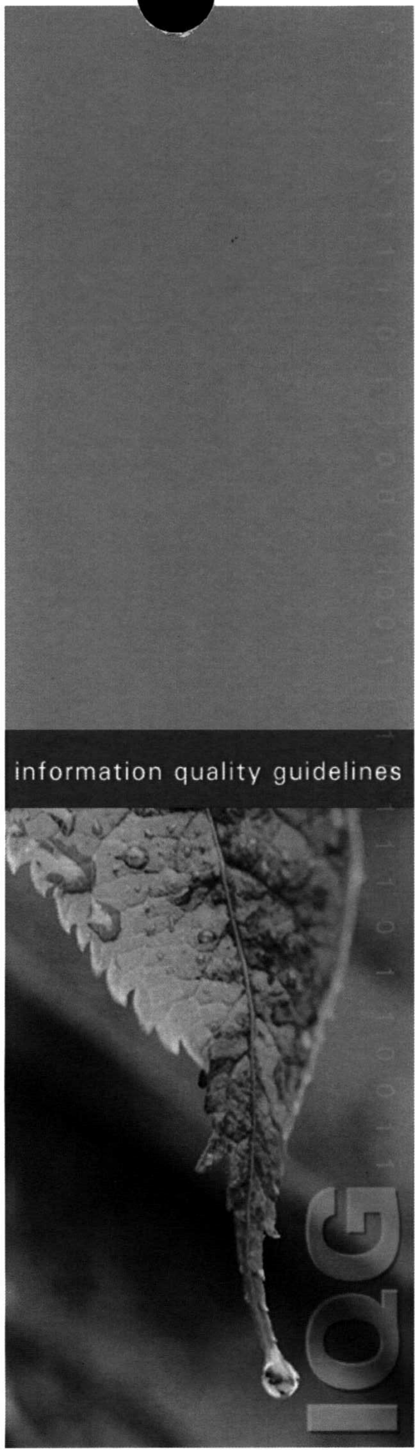

EPA Information Quality Guidelines
Request for Reconsideration (RFR #07001A)

EPA Soil Recontamination Data
Doe Run Herculaneum Lead Smelter
Herculaneum, Missouri

Presented to:
Executive Panel
October 12, 2007

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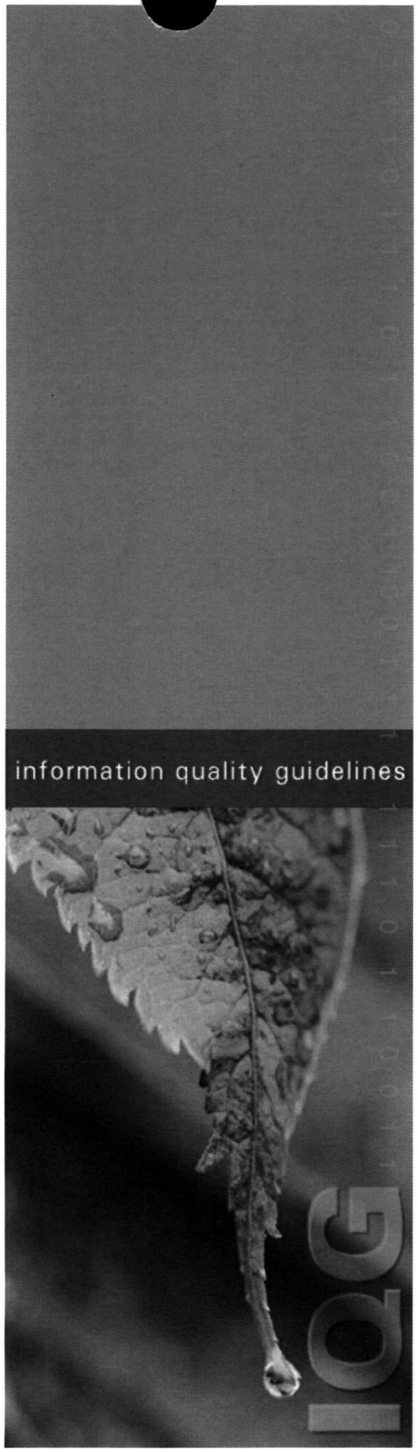
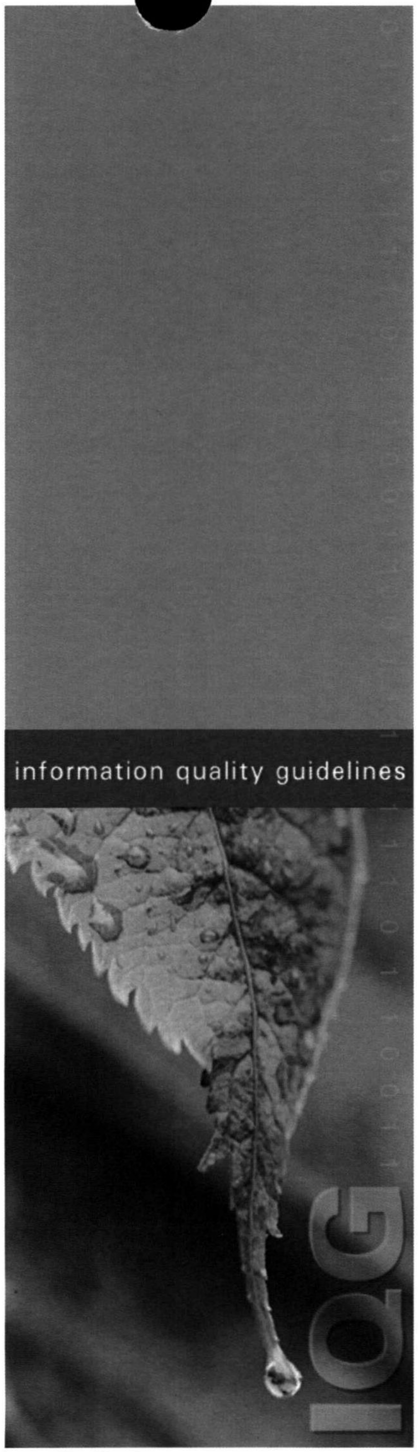


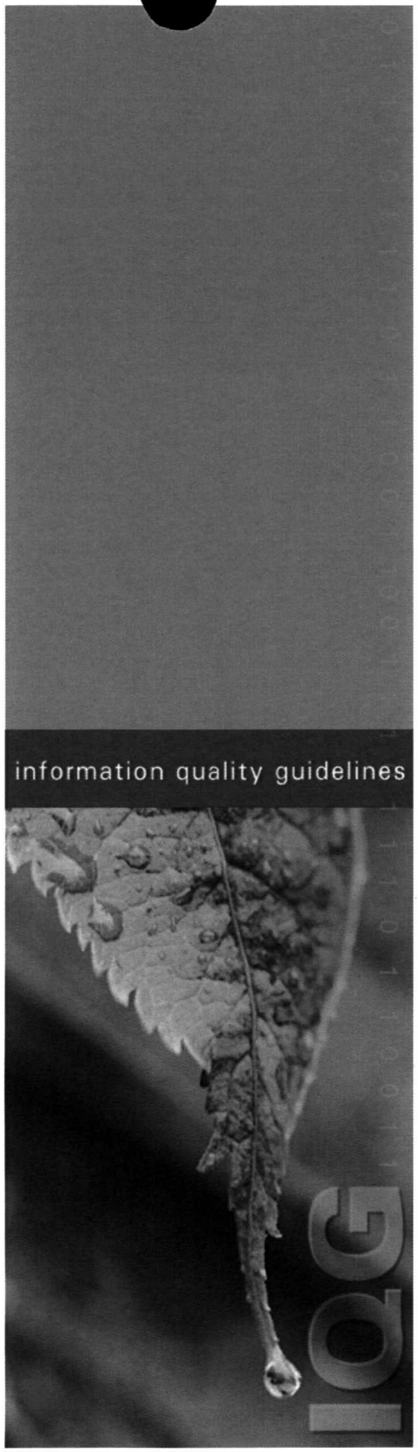
Agenda

- Purpose and Process
- Background - Doe Run Herculaneum Lead Smelter
- Doe Run RFC
- Doe Run RFC Response
- Doe Run Request for Reconsideration
- Technical, Enforcement, Legal and IQG Considerations
- Staff Recommendations
- Discussion
- Next Steps



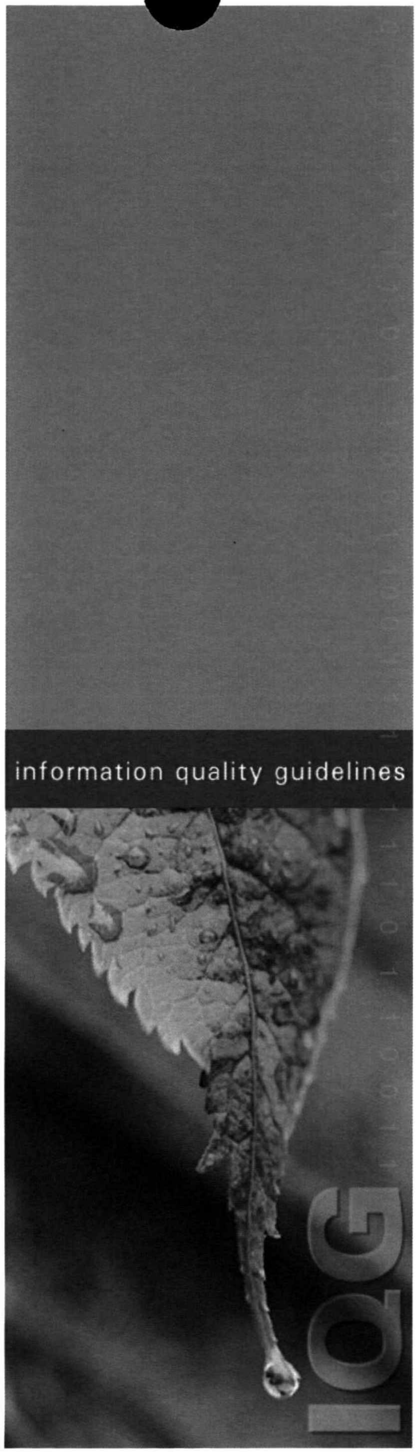
Purpose and Process

- The EPA Information Quality Guidelines (IQG) states an Executive Panel comprised of the CIO, AA for OEI; Science Advisor, AA for ORD; and Economics Advisor, AA for OPEI will make the final decision on Requests for Reconsideration (RFR).
  - The AA for OPEI will not be able to participate on the Executive Panel. He is replaced by the Deputy General Counsel.
  - The CIO is the Chair of the Executive Panel.
- At the conclusion of this meeting, the Executive Panel will decide the appropriate response to the Doe Run RFR.
- In collaboration with the Executive Panel Staff, the Information Owners (Region 7), stakeholders (OSWER) and OGC IQG attorney-advisor, the Quality Staff will draft the Doe Run RFR response letter for the panel's review.
- Upon final approval by the panel, the CIO will send the draft response to OMB for approval to release to the requester.
- The Doe Run RFR response is due on October 31, 2007.



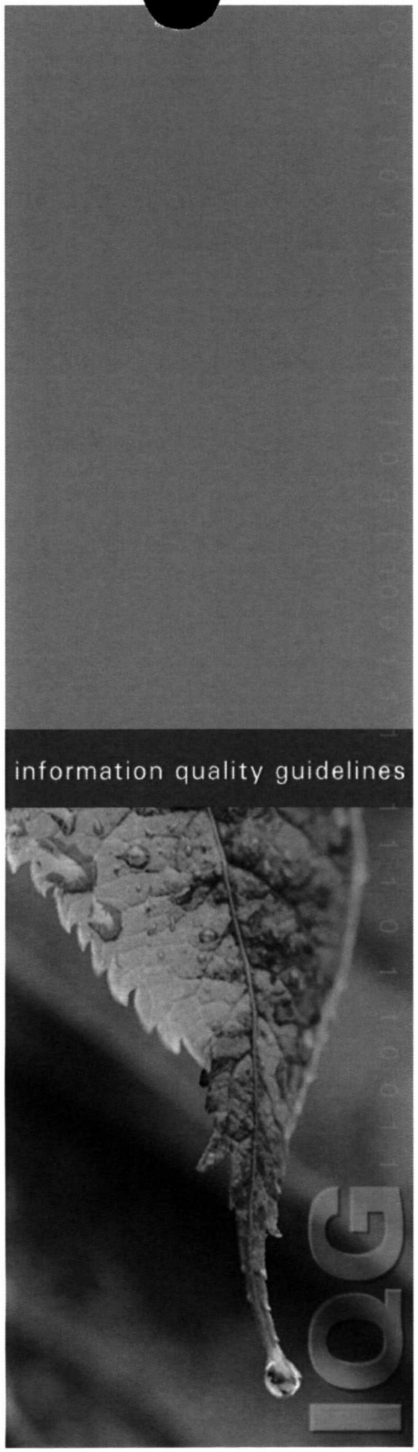
Background

- Doe Run owns and operates the only primary lead smelter in the nation in Herculaneum, Missouri, a town of 2,800 people located along the Mississippi River south of St. Louis.
- Until 2001, ambient air lead levels continuously exceeded the primary lead National Ambient Air Quality Standard (NAAQS). EPA investigations in 2001 found extremely high levels of lead in residential yards, interior dust and streets. Over 50% of the children living close to the smelter had elevated blood lead levels.
- Since 2001, Doe Run, pursuant to EPA orders, has replaced contaminated surface soil at 495 properties near the smelter and taken significant actions to reduce ongoing emissions.
- Herculaneum residents filed a class action against Doe Run; part of the basis for their suit is EPA's sampling data. In September 2007, with a referral to Department of Justice, Region 7 initiated cost recovery of response costs incurred by EPA at the Herculaneum Lead Smelter Site, including costs associated with the recontamination monitoring.
- EPA developed the 2001 QA Project Plan (QAPP) for purposes of performing site characterization of soils in Herculaneum and performing oversight of Doe Run's work. The 2001 QAPP specifies that soil samples are to be collected "from the upper 1 inch of soil".



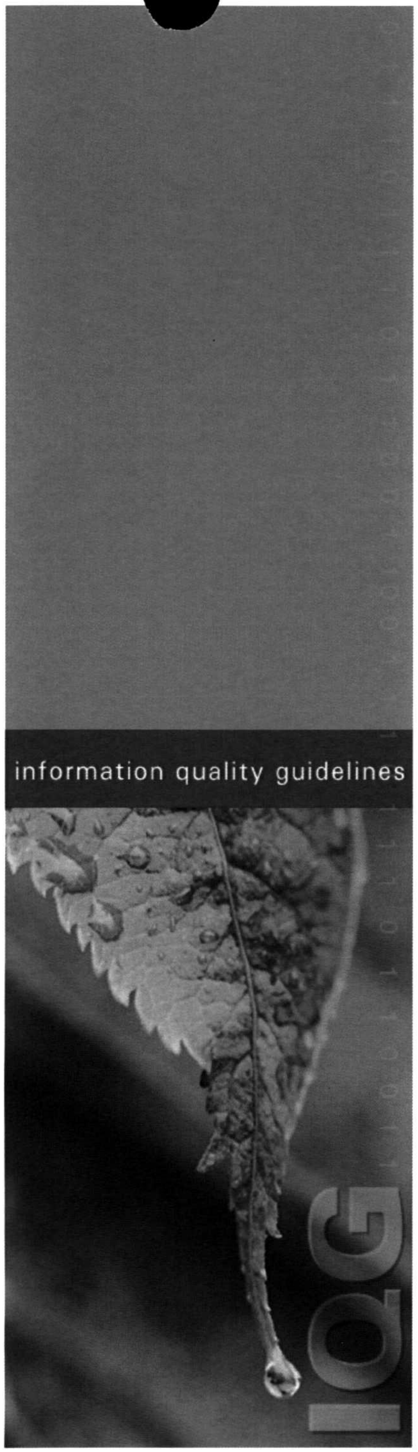
Background (continued)

- The method of collection of the samples was to clear away the surface vegetation if present and use a spoon to collect a sample being careful not to exceed the 1" depth.
- In August 2002, a QAPP was developed to more closely examine air deposition within Herculaneum to potentially predict soil recontamination rates in the top 1" of soil from air data. The sampling involved several methods including artificial surface air monitors, direct XRF (X-Ray Fluorescence) measurements of soil boxes and in-situ surface soils; in addition to ongoing EPA composite surface soil recontamination sampling.
- The 2002 QAPP included as Appendix B the 2001 QAPP developed by EPA for composite surface soil samples which specifies that soil samples are to be collected "from the upper 1 inch of soil" for consistency in the continued collection of the EPA recontamination soil samples. After about 12 months, EPA determined that the data collected using the artificial surface and soil box procedures were not being utilized by Federal or State air programs and these monitoring procedures were subsequently discontinued.
- Despite the discontinuation of the artificial surface and soil box procedures under the 2002 QAPP, EPA contractors continued to collect the composite soil recontamination samples in accordance with the soil sampling procedures described in the 2001 QAPP.



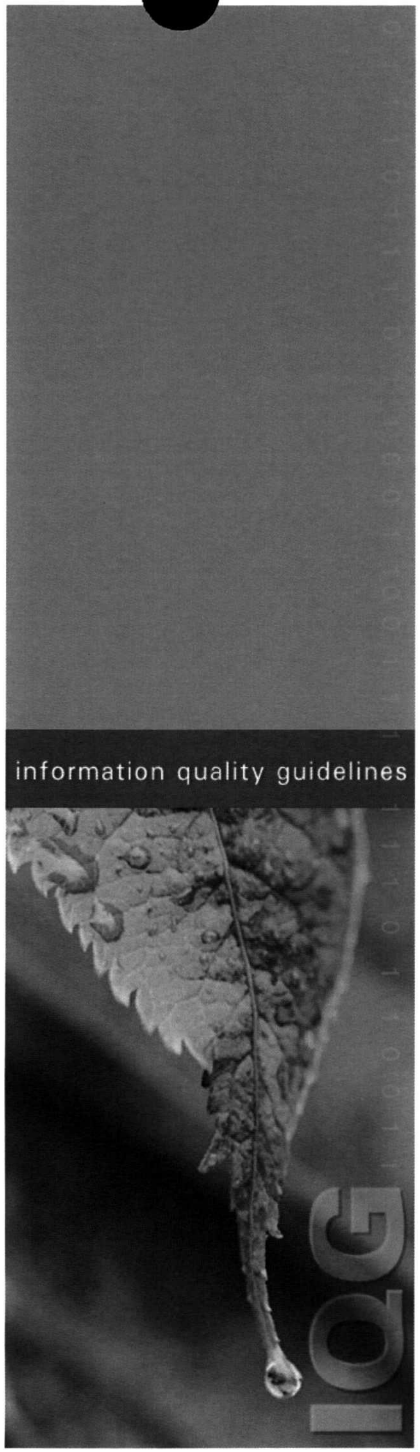
Background (continued)

- Analyses of the EPA residential recontamination soil sampling data show a statistically significant upward trend in increasing lead levels over time for the majority of the areas sampled.
- The lead National Ambient Air Quality Standard (NAAQS) is currently under review. In addition, the Region issued a lead State Implementation Plan (SIP) call to the State of Missouri. The State submitted its revised SIP for EPA approval. EPA's soil monitoring data are being utilized by OAR OAQPS in RTP, as well as the State of Missouri for these reviews.
- EPA Region 7 and Doe Run finalized a RCRA 7003 order on consent to address releases from their transportation of lead-bearing materials. As part of the Administrative Order on Consent, Doe Run is performing the soil sampling, annually.



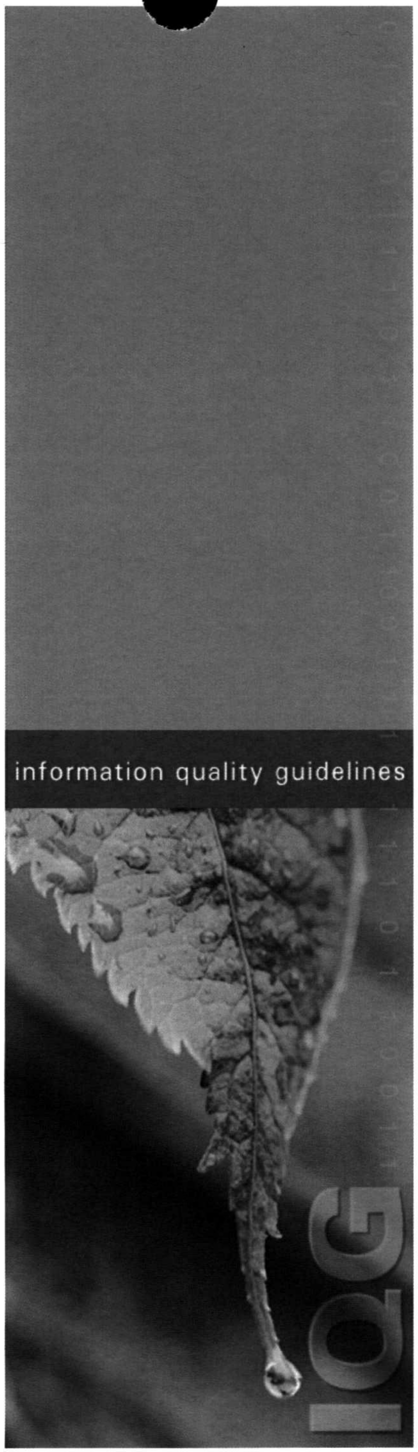
Request for Correction (RFC)

- On October 19, 2006, Doe Run submitted a RFC. In its RFC, Doe Run states:
  - EPA has and continues to disseminate soil recontamination data for Doe Run's Herculaneum Lead Smelter ("HLS") site that fail to comply with the DQA[1] and the EPA Information Quality Guidelines. (RFC, page 1)
  - EPA has repeatedly disseminated soil recontamination data for HLS and warnings to the public derived from these data – which are based on its invalidly changed soil sampling protocol, which EPA switched in 2003 from a one-inch sample to a one-quarter or one-eight inch surface scraping. (RFC, page 3)
  - EPA's Technical Report for Focus Group Recommendations makes it clear that sampling was conducted using a one-inch sample depth in 2002 and then switched to a surface scraping in 2003, indicating that the Trends Report includes data collected under two types of protocols. This issue raises additional data quality questions. (RFC, footnote 2)
- Doe Run alleges that EPA failed to:
  - Follow the correct QAPP
  - Implement the QAPP as written, and
  - Amend the QAPP in a manner consistent with EPA data quality requirements.



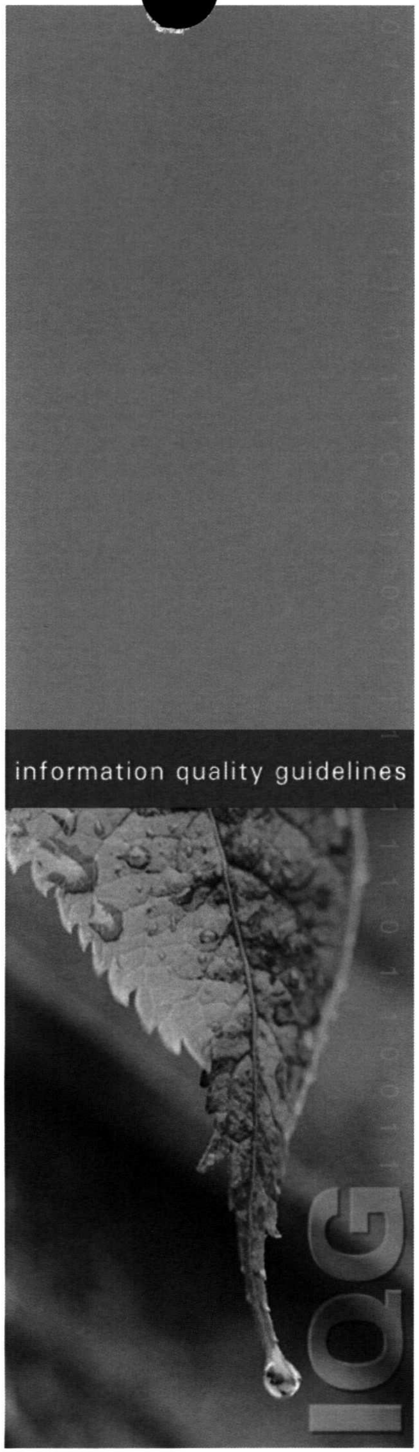
Request for Correction (continued)

- Doe Run proposed that EPA:
  - Conduct the ongoing lead recontamination study by taking samples from the entire top one inch of surface soil. “Doe Run believes the two terms [“from the upper 1 inch” and “top 1 inch”] are synonymous and mean the sample should include soil from the entire top one inch of surface soil.” (RFC, page 8)
  - Reconsider any regulatory decisions it has made based on the compromised data (RFC, page 9)
  - Issue notification to the public and cease disseminating data collected under the soil scraping sampling method until a scientific review can be undertaken of which approach is the more valid for determining recontamination. (RFC, page 9)
  - Include Doe Run as a stakeholder in any process that might lead to a change in EPA’s established standards under the 2001 and 2002 QAPPs. (RFC, page 9)
  - Invalidate the 2006 Addendum to the 2001 QAPP and adhere to a one inch sample depth for soil samples. (RFC, page 10)



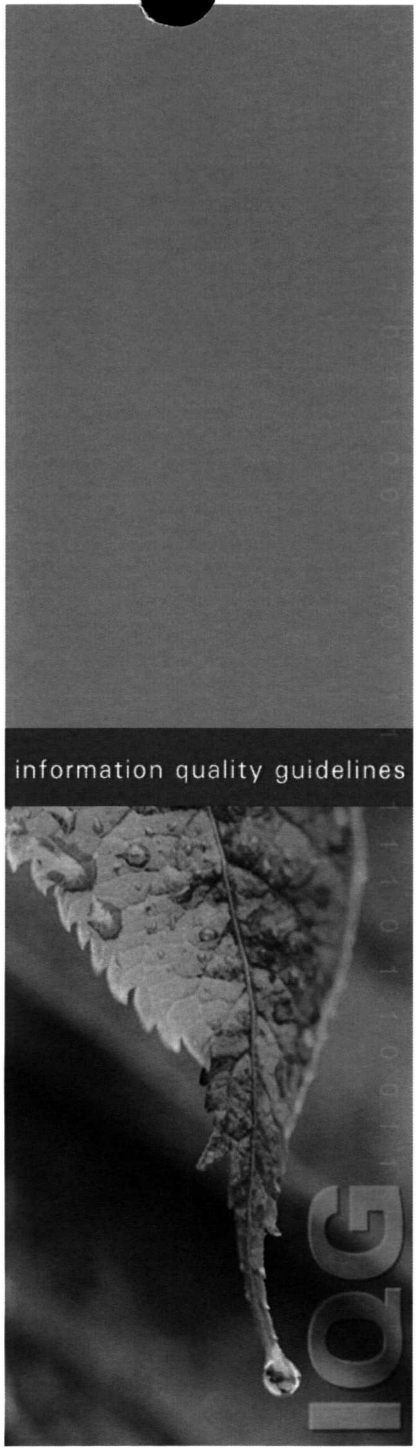
RFC Response

- EPA responded to the RFC on May 14, 2007, as follows:
  - Since the implementation of the 2001 QAPP, EPA has not altered the manner in which it has collected composite soil samples at the Herculaneum site whether for purposes of soil characterization or recontamination monitoring.
  - The soil recontamination data were, and still are being properly collected consistent with the procedures described in the 2001 QAPP.
  - The methodology used to obtain soil recontamination data is consistent with EPA's IQG objectives. No corrections to the data obtained from that methodology are warranted.
  - All QAPPs for HLS were prepared in accordance with *EPA Requirements for QA Project Plans*, EPA QA/R-5 (March 2001), and approved by the EPA Project Manager and the Regional QA Manager or their designee, prior to the initiation of the environmental data generation or use activity.



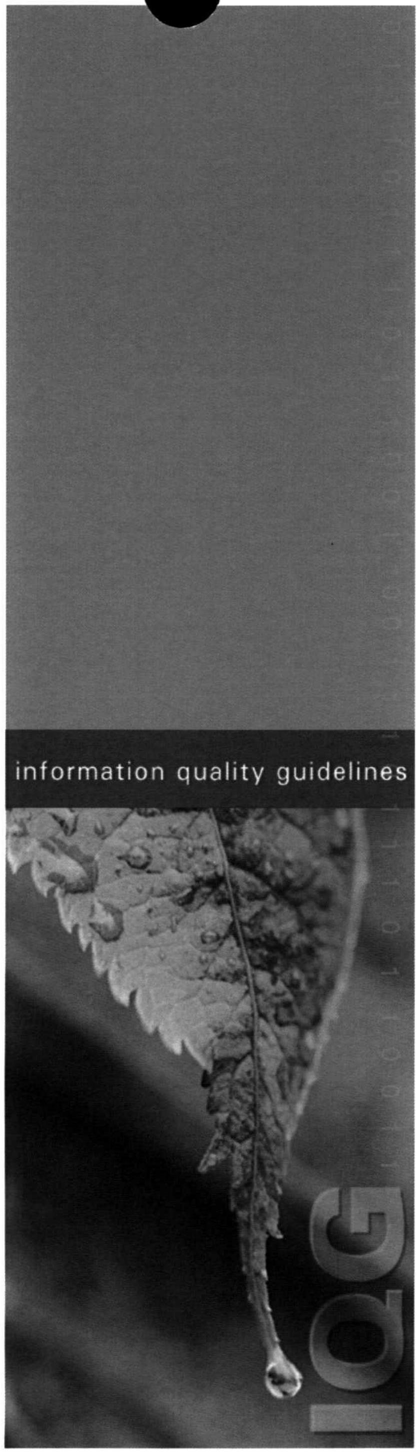
RFC Response (continued)

- EPA responded to the RFC on May 14, 2007, as follows:
  - EPA acknowledged there are documents in the record which may cause confusion as to the soil sampling collection procedures utilized by EPA. To clarify this information, these documents were included in the RFC response:
    - A memorandum to respond to inaccurate statements in the Focus Group Report, which suggest that EPA instituted a change in its surface soil sampling methodology. (May 9, 2007)
    - An addendum to the 2001 QAPP to supersede the August 2006 addendum, to clarify that in practice and since inception of the 2001 QAPP, EPA's soil samples have been collected from the upper portion of the 1 inch soil horizon so as to ensure that a depth of 1 inch is not exceeded. (May 9, 2007)



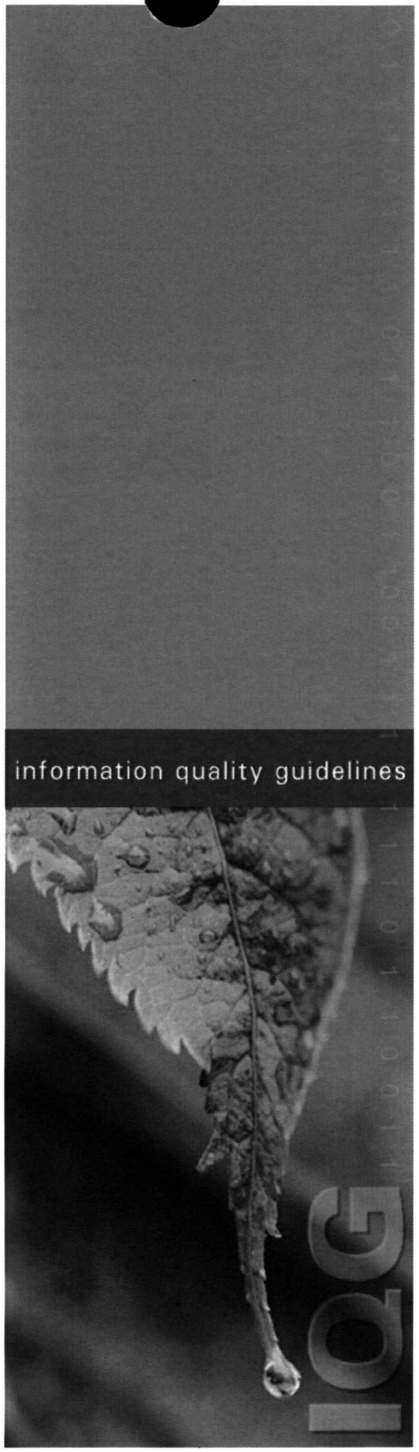
Request for Reconsideration (RFR)

- The Doe Run RFR was received on August 2, 2007. In its RFR, Doe Run states:
  - The steps EPA took to "clarify any potentially confusing statements" regarding soil sampling procedures do not address concerns over the quality of soil recontamination data. (RFR, page 2)
  - Doe Run interprets the "from the upper 1 inch" specification in the QAPP to mean sampling the entire top one inch of soil. Doe Run also asserts:
    - "Allowing samples to be collected from anywhere within the one inch sample horizon allows EPA to pick and choose a sampling depth to achieve almost any desired lead concentration." (RFR, page 3)
    - "It would be difficult for EPA to make a valid assessment of soil concentrations against regulatory actions levels that are based on modeling of concentrations in the top one inch of soil." (RFR, page 3)
    - The action level for lead is based on samples collected from the entire one inch of soil.
    - The reproducibility of soil recontamination is compromised, because the sample collection depths vary from $^{1}/_{8}$ to ½ inch.



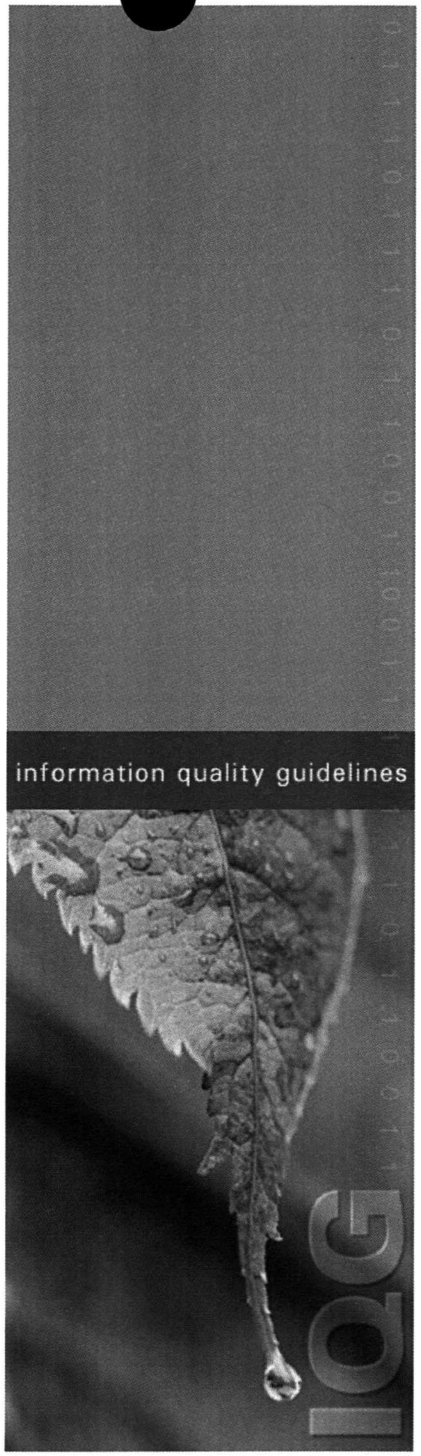
Request for Reconsideration (continued)

- In its RFR, Doe Run states:
  - In an affidavit from Mr. Aaron Miller, Doe Run's Environmental Director of Missouri Operations. Mr. Miller states:
    - When EPA began sampling for lead recontamination in July 2002, EPA collected soil samples at a one-inch depth.
    - An EPA contractor "..stated he collected most of the soil samples at a depth less than ¼ inch with only a few samples going deeper to a maximum depth of ½ inch." (RFR, page 5)
    - EPA's project manager stated that Doe Run should have been on notice that EPA was taking surface scraping samples, based on Dr. Clark's recommendation at the Nov. 20, 2002 Focus Group
  - EPA failed to follow proper data quality procedures and vet the implications of the change before making the change in sampling procedure.
  - EPA's interpretation that the 2001 QAPP allows collection of a soil sample at any depth less than one inch rather than specifically at one inch is flawed.



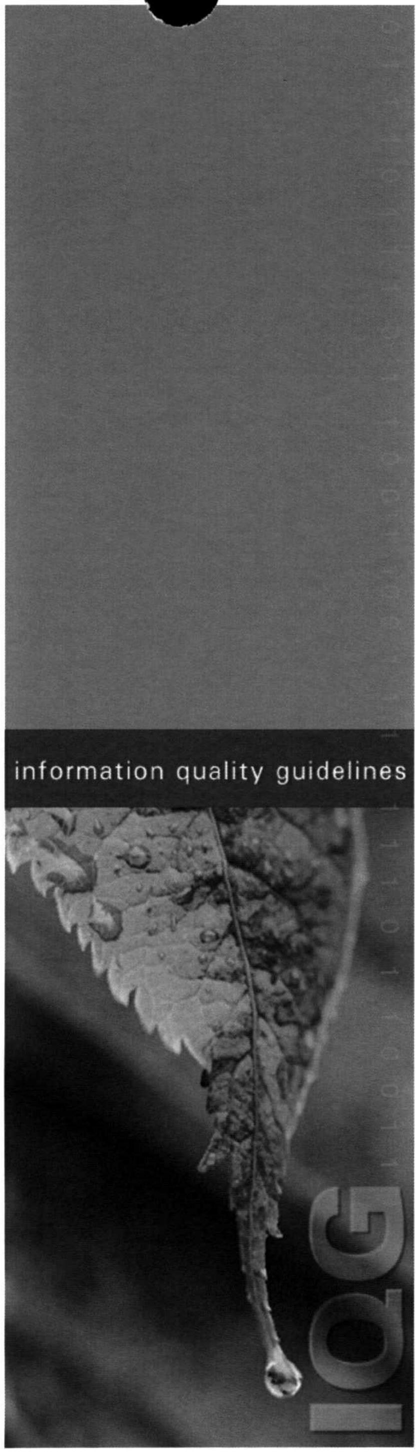
Request for Reconsideration (continued)

- In its RFR, Doe Run proposes the following corrective actions:
  - EPA should interpret "from the upper 1 inch" to require sampling the entire top one inch of soil (or rough equivalent, consistent with practice in the field when measuring devices are not available) for all future sampling. (RFR, page 4)
  - EPA should issue notification to the public and cease disseminating data collected under the soil scraping sampling method until a scientific review can be undertaken of which approach is the more valid for determining recontamination. (RFR, page 4)
  - EPA initiated an investigation to determine the most representative sampling depth. Doe Run believes the appropriate depth study should be related to the applicable risk assessment methodology. (RFR, page 4 & 6)
  - EPA should acknowledge that it materially changed its soil sampling procedure from one-inch samples to surface scrapings in 2003. (RFR, page 6)
  - EPA should withdraw any affected data from the public docket. (RFR, page 6)



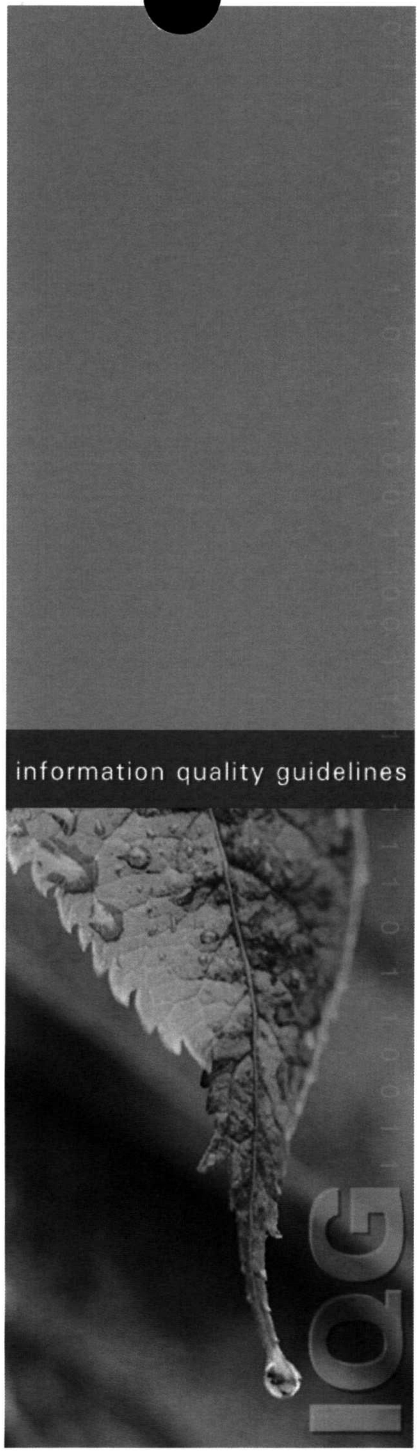
Technical Considerations

- According to the Remedial Project Manager, EPA has not changed its sampling methodology when collecting composite soil samples for the evaluation of lead in surface soils at the site. Variation in sample aliquot depth within the upper 1-inch soil horizon is to be expected and is accounted for by taking multiple aliquots across areas when making composite samples.
- For soil data used in baseline risk assessments, EPA recommends the collection of surface soil from the top two to three centimeters (zero- to one-inch) of the soil layer, below organic litter or sod. (1996 EPA Soil Screening Guidance)
- The Technical Review Workgroup for Metals and Asbestos (TRW) agrees this depth (top one inch) best represents the soil and dust exposure for use in calculation of the predicted child blood lead level using the Integrated Exposure Uptake Biokinetic (IEUBK) model as well as characterization of the mass fraction of soil in indoor dust (MSD). (http://www.epa.gov/superfund/health/contaminants/lead/ieubkfaq.htm#depth1)
  - These recommendations were intended to avoid using data from samples collected at depth (e.g., 0- to 6-inch depth interval) that might dilute contamination that is concentrated in the surface soils, thereby underestimating the exposure (and therefore risk) to children.



Enforcement Considerations

- EPA is seeking reimbursement of Superfund response costs incurred at the Herculaneum Smelter site, including recontamination monitoring costs.
- EPA and Doe Run's recent soil data indicate that many properties in Herculaneum are above EPA's screening level for residential soils and may require response actions to protect human health.

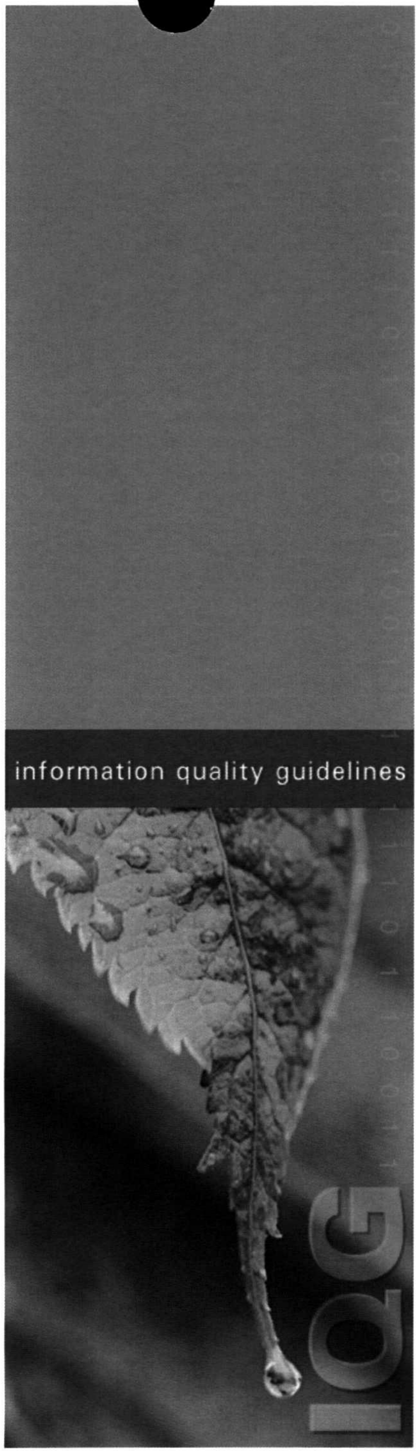


IQG Considerations

- In the Doe Run RFC and RFR, the requester challenges the objectivity and utility of the soil recontamination data collected at Doe Run HLS. The requester alleges the Agency did not follow its Quality System. In the EPA IQG, the Quality System is one of the policies that the Agency states "...helps ensure that EPA organizations maximize the quality of environmental information, including information disseminated by the Agency." (EPA IQG, page 10)

- The development, review and approval of the 2001 and 2002 QAPPs and the 2001 QAPP Addendum are consistent with the policies and procedures documented in the EPA Quality Manual 5360 A1 (May 2000), EPA Order 5360.1 A2 (May 2000), EPA Region 7 Quality Management Plan, Revision No. 2 (August 2001)and EPA QA/R-5: *EPA Requirements for QA Project Plans* (March 2001).

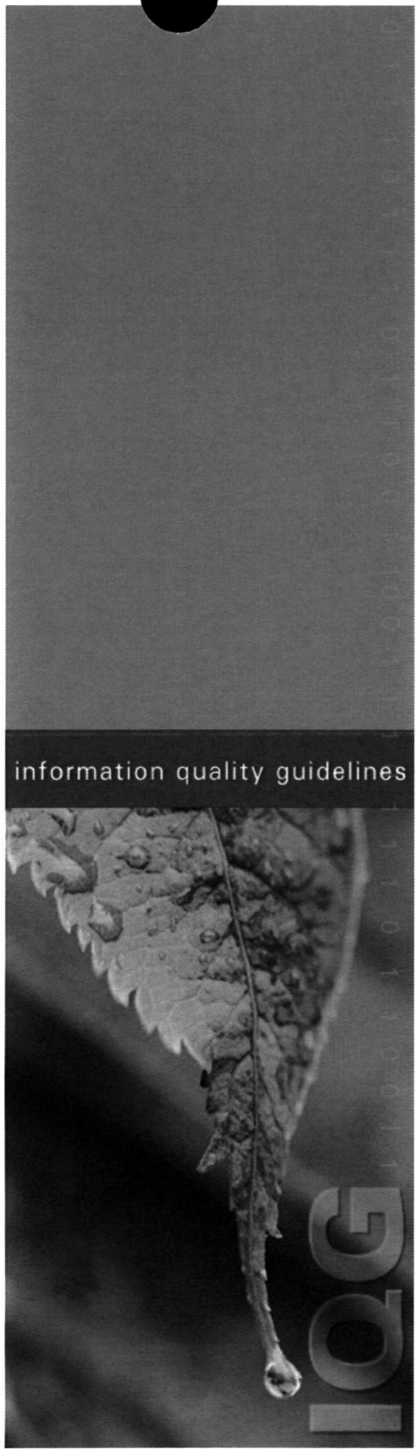
- The memorandum and revised 2001 QAPP addendum that were attached to the RFC response enhances the transparency of the sampling protocols being used at the Doe Run HLS.



DISCUSSION

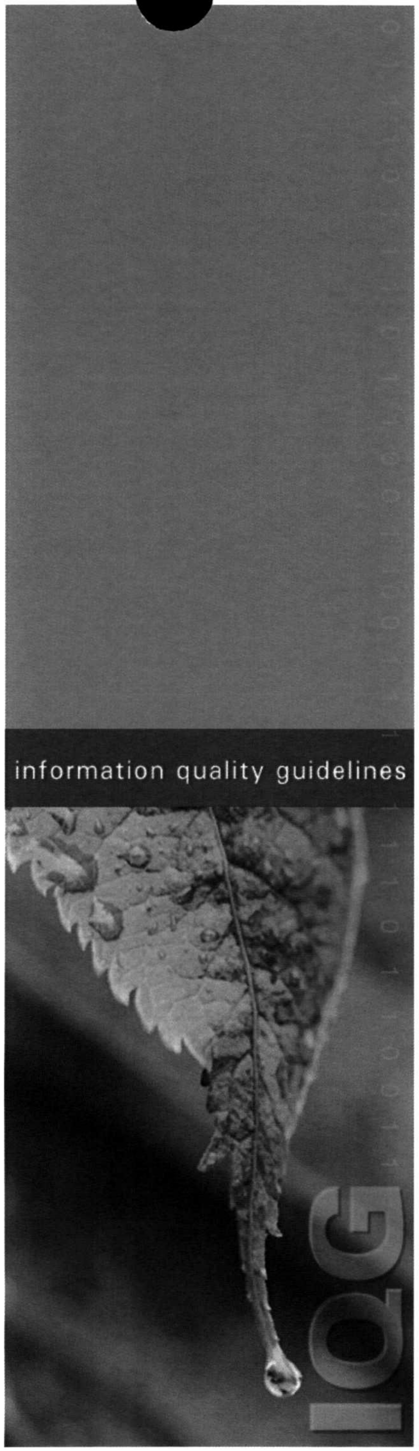
- Did EPA change it's sampling methodology?

- EPA has performed statistical analyses of recent sampling performed by Doe Run at the Herculaneum site using both the EPA upper 1-inch sampling and a surface scraping. The analyses demonstrate that there are only very minor differences between the data results generated by the two methods for the Herculaneum site. The median lead concentrations was 7 ppm higher in surface scraping samples than in the upper 1-inch samples. This is not a significant difference when compared to the soil screening level of 400 ppm for lead in residential soils. In addition, over 40 percent of the surface soil samples collected from the upper 1-inch horizon showed lead concentrations exceeding the corresponding surface scraping sample concentration.



DISCUSSION

- Should EPA do the corrective actions suggested by Doe Run in its RFR?
  - ❑ Interpret “from the upper 1 inch” to require sampling the entire top one inch of soil for all future sampling.
  - ❑ Issue notification to the public and cease disseminating data collected under the soil scraping sampling method until a scientific review can be undertaken of which approach is the more valid for determining recontamination.
  - ❑ Initiate an investigation to determine the most representative sampling depth.
  - ❑ Acknowledge that it materially changed its soil sampling procedure from one-inch samples to surface scrapings in 2003.
  - ❑ Withdraw any affected data from the public docket.



Staff Recommendations for RFR response

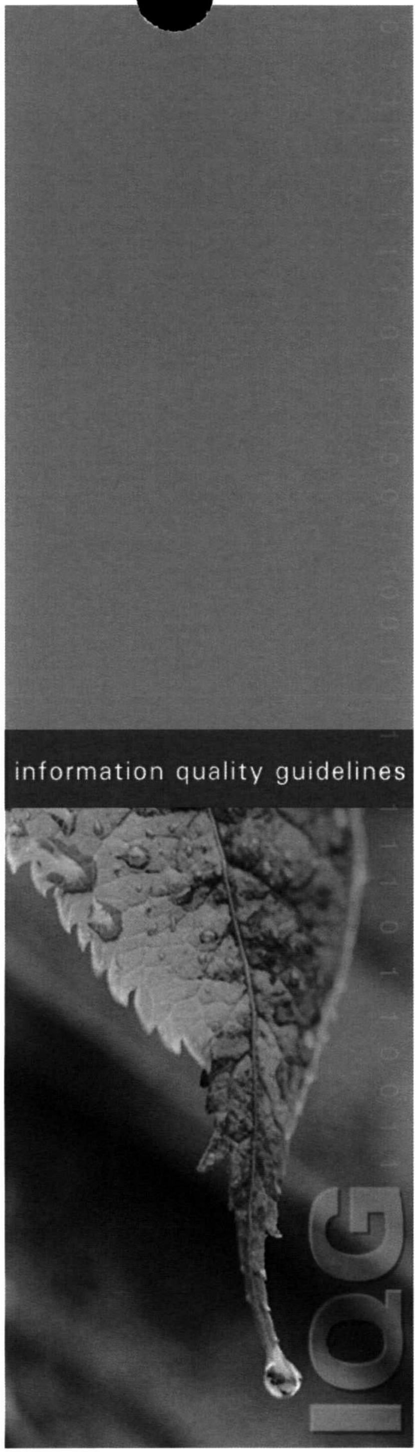
The corrective actions suggested by Doe Run in its RFR are not appropriate, because:

- EPA Region VII interprets "from the upper 1 inch" language in the 2001 QAPP to mean that samples will be taken from the upper portion of the 1-inch soil horizon to ensure that a depth of 1 inch is not exceeded.

- EPA has not changed its sampling methodology when collecting composite soil samples for the evaluation of lead in surface soils at the site. Variation in sample aliquot depth within the upper 1-inch soil horizon is to be expected and is accounted for by taking multiple aliquots across areas when making composite samples. Consequently, no correction of Doe Run HLS recontamination data is required.

- The sampling methodology being used at the Doe Run HLS is suitable for determining surface soil recontamination within the upper one-inch soil horizon at the site. This sampling methodology is consistent with the procedures found in the 1996 EPA Soil Screening Guidance, which recommends the collection of surface soil from the top two to three centimeters (zero to one inch) of the soil layer, below organic litter or sod. This is also consistent with the 1989 Risk Assessment Guidance for Superfund, Part A, which recommends sampling from the shallowest depth that can be practically obtained.

- We note the Technical Review Workgroup for Metals and Asbestos (TRW) believes that the top one inch of soil best represents the soil and dust exposure for use in calculation of the predicted child blood lead level using the Integrated Exposure Uptake Biokinetic (IEUBK) model as well as characterization of the mass fraction of soil in indoor dust (MSD).



Next Steps

Due Date	Action
August 2	EPA receives RFR
August 23	Held scoping meetings with Executive Panel Staff (EPS), Information Owner (IO), Stakeholder and OGC attorney-advisor
October 3	Distributed draft briefing to EPS, IO and OGC
October 9	Finalize Executive Panel Briefing Materials
October 10	Executive Panel Briefing materials distributed to Executive Panel
October 12	Executive Panel Briefing
October 16	Draft RFR response sent to EPS, IO, Stakeholders and OGC attorney-advisor for review and comment.
October 19	EPS, IO, Stakeholders and OGC attorney-advisor reach consensus on the draft RFR response.
October 22	CIO sends draft response to Executive Panel for concurrence to release to OMB for clearance to release to requester.
October 25	Executive Panel approves draft RFR response for release to OMB for clearance
October 29	CIO sends draft response to OMB for clearance
October 31	RFR Response due. Interim response sent to requester. Due date revised.
November 28	Complete final revisions and prepare for OEI CIO's signature
Jan 28, 2008	**RFR response due**

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August 2, 2007

Information Quality Guidelines Staff
United States Environmental Protection Agency
Mail Code 28221T
1200 Pennsylvania Ave., N.W.
Washington, DC 20460

Re: Request for Reconsideration of EPA's Decision on the Doe Run Company's Request for Correction of Information Regarding Soil Sampling at its Herculaneum Lead Smelter Site (RFC No. 07001)

Dear Madam or Sir:

This Request for Reconsideration ("RFR") is filed under the Data Quality Act, (Treasury and General Government Appropriation Act for Fiscal Year 2001, Pub. L. No. 106-554, § 515 Appendix C, 114 Stat. 2763A-153) ("DQA"), and EPA's *Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity, of Information Disseminated by the Environmental Protection Agency*, EPA/260R-02-008, October 2002 ("EPA Information Quality Guidelines"), on behalf of the Doe Run Company ("Doe Run"). Doe Run seeks an appeal of and modifications to EPA's decision dated May 14, 2007 (*see* **Tab 1**) on Doe Run's Request for Correction ("RFC") of information previously submitted on October 19, 2006 (*see* **Tab 2**).

DISCUSSION

I. SUMMARY OF DOE RUN'S RFC AND EPA'S RESPONSE

On October 19, 2006, Doe Run filed an RFC (RFC No. 07001) seeking corrective action for the dissemination of soil recontamination data collected from Doe Run's Herculaneum Lead Smelter ("HLS") site that fail to comply with the DQA and EPA Information Quality Guidelines. Doe Run identified at least three significant potential violations of the DQA and EPA Information Quality Guidelines regarding the soil sampling procedures EPA used at the site. Specifically, Doe Run noted the following violations:

1. EPA ignored or abandoned a more recent and specific Quality Assurance Project Plan ("QAPP") dated August 2002 governing soil recontamination sampling procedures in favor of an older QAPP dated September 2001 without justification and without adhering to the requirements of the EPA Quality Manual;

2. EPA failed to properly implement either the 2001 or 2002 QAPPs by disregarding the specifications and procedures provided in the QAPPs; and

3. EPA's *ex post facto* amendment of the 2001 QAPP in September 2006 is in direct violation of QAPP revision procedures specified in the EPA Quality Manual.

These violations resulted when EPA decreased the sampling depth for soil recontamination monitoring at HLS. EPA failed to follow its own mandated data quality procedures or vet the technical implications of the change. As Doe Run noted in the RFC, the effect of sampling anything less than the QAPP-specified full one-inch of soil is to make the test for lead recontamination more variable than intended by the QAPP and potentially more sensitive.

Doe Run requested that EPA implement several corrective actions to address these violations including: (1) adhering to a sampling depth of one inch until there has been shown to be an adequate and demonstrated basis for changing the sampling depth, (2) reconsider any regulatory decisions EPA has made based on data affected by the violations, and (3) issue notification to the public and cease disseminating data collected in violation of data quality guidelines until and unless EPA conducts a scientific review to determine what sampling depth is appropriate for determining soil recontamination.

EPA's May 14, 2007 response, however, fails to acknowledge that EPA improperly changed the sampling depth used at HLS or that this change affects the quality of the sampling results. Instead, EPA acknowledges "that there are documents in the record which may cause confusion as to the soil sampling collection procedures utilized by EPA," but ultimately maintains that "the soil recontamination data was, and still is being properly collected." (*See* EPA's Decision, **Tab 1** at p. 1). As a result, EPA does not plan to take any corrective actions to address the impact of varying soil sampling depths at HLS. Doe Run asks the EPA to reconsider its decision.

II. DISCUSSION OF DISAGREEMENT WITH EPA'S RESPONSE

Doe Run believes EPA's conclusions that "the methodology used to obtain soil recontamination data is consistent with EPA's objectives of quality, objectivity, utility, and integrity" and that "no corrections to the data obtained from that methodology are warranted" are erroneous because they are based on EPA's flawed interpretation of what "upper one inch of soil" means. (*Id.* at p. 3). Moreover, the steps EPA took to "clarify any potentially confusing statements" regarding soil sampling procedures[1] are not sufficient to address concerns over the quality of soil recontamination data. (*Id.*).

[1] EPA's response included two accompanying memoranda to "clarify" confusing statements in record: (1) memorandum from B. Morrison, EPA Region VII Project Manager, to the Site File and Administrative Record stating that EPA's Focus Group Report is inaccurate when it reports that EPA changed its sampling procedure from one inch samples to "surface scraping" after finding no evidence of recontamination from initial samples collected at one inch, *see*

A. Interpretation of "Upper One Inch"

At the heart of the controversy is the specification in the 2001 QAPP that soil "samples will be collected from the upper 1 inch of soil." (2001 QAPP, **Tab 3** at p. 7). Doe Run interprets this specification to require sampling the entire top one inch of soil (or rough equivalent, consistent with practice in the field when measuring devices are not available).

In contrast, EPA's response to Doe Run's RFC continues to support a flawed interpretation of "upper one inch" and states as follows: "[i]t is to be noted that the 2001 QAPP envisions collection of soil samples from the upper inch of soil; it does not specify where, within that upper inch, the sample is to be collected." (EPA's Decision, **Tab 1** at p. 2). Essentially, EPA contends that "upper 1 inch" allows the collection of soil samples using any part of the soil within the top inch.

EPA's interpretation presents data quality issues. First, regulatory decision points are based on air deposition modeling in the top inch of soil. For example, the 2002 QAPP specifies the "action level set in this plan [for lead recontamination] is 25 ppm/yr *in the top 1 in. of soil*" (emphasis added, 2002 QAPP, **Tab 4** at § 2.5). Allowing samples to be collected from anywhere within the one inch sample horizon allows EPA to pick and choose a sampling depth to achieve almost any desired lead concentration. In a public meeting with City of Herculaneum on March 16, 2004, Bruce Morrison, EPA Region VII Project Manager, said that EPA will use surface scrapings samples ranging from 1/8 inch to ¼ inch because taking a one-inch scoop sample would "dilute" lead concentrations in the soil. (*See* Affidavit of Aaron W. Miller, Tab 5 at ¶ 9). In another example, EPA's September 2006 amendment to the 2001 QAPP attempted to interpret "upper 1 inch" to mean surface scrapings "not to exceed 0.5 inches in depth" based on the "nature of an ongoing source of lead at the site which is identified as the emissions from the lead smelter in Herculaneum." (*see* QAPP Amendment, **Tab 5**). EPA withdrew the amendment to the 2001 QAPP as part of its response to Doe Run's RFC, but the example nonetheless illustrates the potential dangers of allowing such a vague interpretation of "upper 1 inch." (*See* Attachment 2 to EPA's Decision, **Tab 1**).

Doe Run believes such an interpretation also would violate EPA's *Quality Manual for Environmental Programs*, EPA Order 5360 A1, May 5, 2000 ("EPA Quality Manual," available at http://www.epa.gov/OUALITY/qs-docs/5360.pdf, last visited July 10, 2007). EPA Quality Manual § 5.3.1 states that the QAPP must provide sufficient detail to demonstrate that "the intended measurements or data acquisition methods are appropriate for achieving the project objectives." In this case, EPA intends to compare soil recontamination data against specific regulatory action levels that are based on modeling of concentrations in the top one inch of soil. It would be difficult for EPA to make a valid assessment of soil concentrations against these regulatory action levels if the soil sample is not also taken from the entire top one inch of soil.

Attachment 1 to EPA's Decision, **Tab 1**; and (2) memorandum from B. Morrison, EPA Region VII Program Manager, to EPA Quality Assurance Branch withdrawing a September 2006 amendment to the 2001 QAPP which interpreted "upper 1 inch" in the 2001 QAPP to mean surface soil scrapings "not to exceed 0.5 inches in depth," *see* Attachment 2 to EPA's Decision, **Tab 1**.

Failure to interpret "upper 1 inch" to mean sampling the entire top inch of soil or rough equivalent calls into question the validity of the comparison and the objectivity and utility of the data.

A second data quality issue is the reproducibility of soil recontamination data if EPA allows sampling depths to vary. Until the concentration profile of lead at different sampling depths as a function of distance from the facility is well understood, we have no way of knowing the extent to which variability in sampling depths would compromise the ability to analyze recontamination trends. In theory, collection of samples shallower than one inch would result in an effective concentration of detected lead levels, which could make the test for lead recontamination more sensitive than intended. Increased variability and the lack of reproducibility would affect the utility of the data.

1. Proposed Corrective Actions

Doe Run proposes that EPA interpret "upper 1 inch" to require sampling the entire top one inch of soil (or rough equivalent, consistent with practice in the field when measuring devices are not available) for all future sampling. EPA should issue notification to the public and withdraw any affected data from the public docket. If EPA believes a different sampling depth might be a more appropriate representation of lead exposure for future sampling, EPA should initiate an investigation to determine the most representative sampling depth. This investigation also should address other issues that could affect exposure assessments such as speciation.

B. Accuracy of the Focus Group Report

Doe Run's RFC cites statements in EPA's *Technical Report for Focus Group Recommendations, Herculaneum, MO,* dated October 6, 2003 ("Focus Group Report") that document a material change in the soil sampling procedure EPA used to monitor soil recontamination at Herculaneum. The Focus Group Report states that initial recontamination study results collected in 2002 using one-inch soil sampling depths found "no evidence that the replaced soil is becoming contaminated during the first year since said replacement." (*See* Focus Group Report, **Tab 6** at p. 11). EPA staff then decided that "[s]urface scraping samples are a more sensitive indicator of contamination of the replaced soil by lead dust" and the surface scraping procedures "were instituted by the EPA in Herculaneum in 2003." (*Id.*). Doe Run's RFC asserts that EPA violated the DQA and EPA Information Quality Guidelines by making this material change in sampling procedure without following EPA-mandated data quality procedures or vetting the technical implications of the change.

In its response, EPA states that the Focus Group Report is inaccurate and that "[s]ince implementation of the QAPP, EPA has not altered the manner in which it has collected soil samples at the Site, whether for purposes of soil characterization or soil recontamination monitoring, despite any statements that suggest otherwise in the Technical Report for Focus Group Recommendations, Herculaneum, MO." Concurrent with it's response, EPA provided a memorandum to the administrative record from Bruce Morrison (EPA Region VII Program Manager) announcing that statements in the Focus Group Report asserting that EPA changed its sampling procedures in 2003 are inaccurate.

Doe Run questions the accuracy of EPA's clarification with respect to the Focus Group Report and asks EPA to reconsider its assessment. Doe Run has documentation, independent of the Focus Group Report, demonstrating that EPA Region VII shifted from one-inch samples to surface scrapings following recommendations from the Focus Group. Doe Run has an affidavit from Mr. Aaron Miller, Doe Run's Environmental Director of Missouri Operations, documenting a March 16, 2004 conversation between Mr. Miller and Mr. Ryan Schuler, EPA's sampling contractor, and a March 16, 2004 conversation between Mr. Miller and Mr. Bruce Morrison, EPA Region VII Program Manager, regarding soil sampling at HLS. (*See* Affidavit of Aaron W. Miller, **Tab 7**). During Mr. Miller's conversation with Mr. Schuler, Mr. Schuler stated he collected most of the soil samples at a depth less than ¼ inch with only a few samples going deeper to a maximum depth of ½ inch. (*Id.* at ¶ 4). Mr. Schuler also acknowledged that he knew the 2001 QAPP required a one-inch sampling depth. (*Id.* at ¶ 5). Mr. Miller's affidavit notes that when EPA began sampling for lead recontamination in July 2002, EPA had collected soil samples at a one-inch depth. (*Id.* at ¶ 2).

At a public meeting with the City of Herculaneum that same evening, Mr. Morrison approached Mr. Miller to discuss Doe Run's concerns regarding EPA's use of ¼ inch soil scrapings. (*Id.* at ¶ 6). Mr. Morrison responded that Dr. Clark who co-authored the Focus Group Report recommended that EPA take surface scrapings instead of the traditional one-inch sample for monitoring recontamination from air deposition. (*Id.* at ¶ 8). Mr. Morrison told Mr. Miller that the recommendation to take surface scrapings appears in the Focus Group Report. (*Id.*). During the meeting, Mr. Morrison described EPA's soil sampling procedure as "scraping the top 1/8 to ¼ inch of the soil." (*Id.* at ¶ 9). Mr. Miller's affidavit describing the conversations between Mr. Miller and Mr. Schuler and between Mr. Miller and Mr. Morrison supports the Focus Group Report's account of EPA's change in soil sampling procedure in 2003.

In addition, EPA's withdrawn September 2006 Amendment to the 2001 QAPP corroborates EPA's intention to require a shallower sampling depth for monitoring soil recontamination (*i.e.*, less than ½ inch). EPA believed the "nature of an ongoing source of lead at the site which is identified as the emissions from the lead smelter in Herculaneum" warranted the change. (*See* QAPP Amendment, **Tab 5**). As discussed in the RFC, EPA failed to follow proper data quality procedures and vet the implications of the change before making either the change in sampling procedure in 2003 as described in the Focus Group Report or the 2006 Amendment to the 2001 QAPP. These data quality deficiencies likely led, in part, to EPA's decision to withdraw the 2006 Amendment.

EPA's assertion that it did not change its sampling procedure appears to be based solely on EPA's flawed interpretation that the 2001 QAPP allows collection of a soil sample at any depth less than one inch rather than specifically at one inch. Under its interpretation of the QAPP, EPA would argue that collecting a sample at ¼ inch is the same as collecting a one-inch sample and that both sampling depths fall within its interpretation of QAPP soil sampling specifications. As discussed above, EPA's interpretation of the QAPP raises significant data quality concerns.

1. Proposed Corrective Actions

Doe Run proposes that EPA acknowledge that it materially changed its soil sampling procedure from one-inch samples to surface scrapings in 2003 without following EPA-mandated data quality procedures. EPA should issue notification to the public and withdraw any affected data from the public docket. As suggested above, if EPA believes a different sampling depth might be a more appropriate representation of lead exposure for future sampling, EPA should initiate an investigation to determine the most appropriate sampling depth and vet this change through the required data quality procedures. The appropriate depth study should be related to the applicable risk assessment methodology, the validation of that risk assessment methodology, and to models against which the collected data are being compared.

III. CONTACT INFORMATION

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IV. CONCLUSION

Doe Run asks that EPA reconsider its response to Doe Run's RFC and adopt the proposed corrective actions. EPA's May 14, 2007 response continues sampling practices that undermine the quality, objectivity, utility, and integrity of the soil sampling data collected at HLS. EPA's acknowledgement of the deficiency of its current soil sampling protocol and associated data is required to maintain the credibility of the sampling program.

Respectfully submitted,

Khouane Ditthavong

KD

Enclosures

cc: Louis Marucheau

BEFORE THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

AFFIDAVIT OF AARON W. MILLER

Affadavit

Aaron W. Miller, being first duly sworn, deposes and says as follows:

1. I make this affidavit based on my personal knowledge and information. I am employed by the Doe Run Company as the Environmental Director for Missouri Operations at Doe Run's Herculaneum Lead Smelter facility. My responsibilities include ensuring compliance with applicable environmental, safety, and health laws and regulations at Doe Run facilities in Missouri. I also supervise environmental sampling and analysis for compliance monitoring and other environmental studies.

2. In July 2002, the U.S. Environmental Protection Agency ("EPA") began conducting soil recontamination sampling in Herculaneum, MO. At that time, all soil samples were taken at a depth of one inch per the applicable 2001 Quality Assurance Project Plan ("QAPP") based on reports to me from Doe Run employees in the field.

Conversation with Mr. Ryan Schuler, EPA's Sampling Contractor for Herculaneum, MO

3. On March 16, 2004, I had a conversation with Mr. Ryan Schuler regarding lead recontamination sampling in Herculaneum. At the time, Mr. Schuler was a contractor to EPA and responsible for conducting environmental sampling in Herculaneum on EPA's behalf. He worked for Seagull Environmental Technologies, Inc. as a Project Manager/Environmental Scientist.

4. During the conversation, I asked Mr. Schuler to explain the soil sampling procedures used at Herculaneum sites. He stated that soil samples were collected by scraping the soil with a spoon to a depth of less than ¼ inch. Mr. Schuler confirmed that most of the ongoing soil samples were taken at a depth of ¼ inch with only a very few samples going deeper to a maximum of ½ inch. He stated that the deeper ½-inch samples were required when sampling from a location with an established lawn where it is difficult to get a surface scraping.

5. I responded to Mr. Schuler that the applicable QAPP requires taking soil samples at a one-inch depth. Mr. Schuler stated that he knew the QAPP required one-inch soil samples.

Conversation with Mr. Bruce Morrison, EPA Region VII Program Manager

6. The same evening following my conversation with Mr. Schuler, I attended a public meeting sponsored by the City of Herculaneum regarding lead issues in Herculaneum. At this meeting, Mr. Bruce Morrison, EPA Region VII Program Manager, who is responsible for overseeing lead recontamination sampling in Herculaneum, approached me to discuss Doe Run's concerns with EPA's lead recontamination study.

7. I stated that Doe Run was concerned that EPA was not collecting soil samples according to the QAPP. I explained to Mr. Morrison that the QAPP requires a one-inch sample and that Mr. Schuler had just told me that soil samples were collected by scraping only the top ¼-inch of soil.

8. Mr. Morrison responded that he knew I had attended EPA's Focus Group meeting on indoor lead dust contamination on November 20, 2002 at which Dr. C. Scott Clark, who led the group, said that the best way to sample for lead recontamination is to scrape the surface instead of taking the traditional one-inch sample. Mr. Morrison stated that I should have been on notice that EPA was taking surface scraping samples based Dr. Clark's recommendation. Mr. Morrison added that Dr. Clark's recommendation was included in the final Focus Group report.

9. Following our conversation, Mr. Morrison made a presentation at the meeting. During this presentation, he described EPA's soil sampling procedure as "scraping the top 1/8 to ¼ inch of the soil." He stated that this scraping procedure would result in a "better" number for lead soil levels because a one-inch soil sample would "dilute" the lead in the soil and not show true deposition.

The foregoing is true to the best of my knowledge and information.

FURTHER AFFIANT SAYETH NAUGHT.

Respectfully submitted,

Aaron W. Miller

Aaron W. Miller

Sworn and subscribed to before me this 1 day of August 2007.

Laurie A. Ferretti

Notary

My commission expires Aug. 26, 2009.

LAURIE A. FERRETTI
Notary Public - Notary Seal
State of Missouri
Jefferson County
My Commission Expires Aug. 26, 2009
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October 19, 2006

Information Quality Guidelines Staff
United States Environmental Protection Agency
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RFC

Re: Request for Correction of Information under the Data Quality Act Regarding EPA (Region VII) Dissemination of Information with respect to the Herculaneum Lead Smelter Site, Herculaneum, Missouri

Dear Madam or Sir:

This Request for Correction ("RFC") of information is filed under the Data Quality Act, (Treasury and General Government Appropriation Act for Fiscal Year 2001, Pub. L. No. 106-554, § 515 Appendix C, 114 Stat. 2763A-153) ("DQA"), and EPA's *Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity, of Information Disseminated by the Environmental Protection Agency*, EPA/260R-02-008, October 2002 ("EPA Information Quality Guidelines"), on behalf of the Doe Run Company, which produces lead and lead products at its Herculaneum, Missouri facility.

EXECUTIVE SUMMARY

EPA has and continues to disseminate soil recontamination data for Doe Run's Herculaneum Lead Smelter ("HLS") site that fail to comply with the DQA and EPA Information Quality Guidelines. In 2001, Doe Run began remediating the top 12 inches of soil from properties surrounding HLS and implementing control strategies to reduce overall emissions from the site. In 2002, EPA began monitoring the remediated soil for potential lead recontamination from ongoing operations at HLS using one-inch samples as specified in the operative quality assurance project plan ("QAPP"). According to EPA's *Technical Report for Focus Group Recommendations, Herculaneum, MO* ("Focus Group Report") dated Oct. 6, 2003, the results reported in 2002 using the specified one-inch sample depths found "no evidence that the replaced soil is becoming contaminated during the first year since said replacement." **(Tab**

1, p. 11). After this finding of no lead recontamination, EPA staff decided that "[s]urface scraping samples are a more sensitive indicator of contamination of the replaced soil by lead dust and were instituted by the EPA in Herculaneum in 2003." (*Id.*)

However, in adopting this more "sensitive" surface scraping approach, EPA failed to comply with the DQA and its own information quality guidelines by implementing the change without following EPA-mandated data quality procedures or vetting the technical implications of the change. Specifically, EPA has failed to: (1) follow the correct QAPP, (2) implement the QAPP as written, and (3) amend the QAPP in a manner consistent with EPA data quality requirements. These failures call into serious question the quality of the lead recontamination data that EPA (specifically Region VII) disseminates to the public and uses for making regulatory decisions.

Doe Run did not learn of the change in sampling procedure until 2004, and objected immediately when the information came to light. Since 2004, Doe Run has been in contact with EPA staff in Region VII and at Headquarters in an attempt to resolve this problem, but EPA has failed to address the data quality concerns. This RFC asks that EPA bring its HLS lead recontamination study into compliance with the DQA and cease disseminating data affected by these data quality concerns.

DISCUSSION

I. CONTACT INFORMATION

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II. DESCRIPTION OF NON-COMPLIANT INFORMATION

EPA has repeatedly disseminated soil recontamination data for HLS – and warnings to the public derived from these data[1] – which are based on its invalidly changed soil sampling protocol, which EPA switched in 2003 from a one-inch sample to a one-quarter or one-eighth-inch surface scraping. Specifically – in contrast to the data that EPA gathered in 2002, using a one-inch soil sample, which showed "there does not appear to be any evidence that the replaced soil is becoming contaminated during the first year since soil replacement" (Focus Group Report, **Tab 1**, p. 11) – at least seven documents disseminated through EPA Region VII's website or through EPA's Herculaneum Lead Smelter Community Advisory Group ("CAG") now report increasing lead recontamination at Herculaneum. These documents cite data and information concerning lead recontamination in the area surrounding HLS that EPA collected in a manner contrary to the *EPA Quality Manual for Environmental Programs,* EPA Order 5360 A1, May 5, 2000 ("EPA Quality Manual," which is available at http://www.epa.gov/QUALITY/qs-docs/5360.pdf). The seven documents include the following:

1. *Lead Soil Trend Analysis Through May, 2006 - Evaluation by Individual Quadrant, Herculaneum Lead Smelter Site, Herculaneum, Missouri* (2006, available at http://www.epa.gov/region7/cleanup/superfund/herculaneum_pbtrend_thru_may2006.pdf, last visited October 19, 2006; *see* **Tab 2**). The report states the "trend analysis identified 14 out of 17 properties where at least one quadrant showed a statistically significant increasing trend [in recontamination]."[2]

2. *EPA Fact Sheet: Herculaneum Smelter Site, Herculaneum, Missouri* (September 2006; distributed at the September 19, 2006 Meeting of the Herculaneum Lead Smelter CAG; *see* **Tab 3**). This fact sheet states:

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[1] Doe Run also is concerned that EPA is disseminating potentially questionable lead recontamination data through means other than EPA publications and websites. There have been numerous press reports quoting and citing EPA staff on the issue of lead recontamination at Herculaneum. A recent example is a July 21, 2006 article in the St. Louis Post-Dispatch. The article, titled *Neighbors Hope Doe Run Revitalizes Land,* by Benjamin Poston, reports: "Bruce Morrison, the Herculaneum lead cleanup project manager for the EPA, said his agency continued to monitor yard soils for recontamination within four-fifths of a mile from the smelter, a process that began in 2002. The U.S. EPA recently has detected eight samples within one-half mile of the smelter that contained lead contamination exceeding the acceptable federal level of 400 parts per million." (**Tab 4**).

[2] Note that this report includes data from early 2002 (sampling round 6) through May 2006 (sampling round 23). EPA's Technical Report for Focus Group Recommendations makes it clear that sampling was conducted using a one-inch sample depth in 2002 and then switched to a surface scraping in 2003, indicating that the Trends Report includes data collected under two types of protocols, an issue that raises additional data quality questions.

> Fact #3: Recontamination of Herculaneum, after yard clean up, house interior clean up, road clean up and stated efforts to control emissions from the Doe Run Smelter, has been and continues to occur. This fact is based on the ongoing data collection conducted by the EPA.

3. *EPA Fact Sheet: Quarterly Update for Herculaneum Lead Smelter Site, Herculaneum, Missouri* (February 2006, available at http://www.epa.gov/Region7/news_events/factsheets/fs_quarterly_update_herculaneum_lead_smelter_herculaneum_mo0206.htm, last visited October 19, 2006; *see* **Tab 5**). This fact sheet states:

> EPA monitors for lead recontamination in surface soils every six months. The data indicate that lead levels are trending upward in areas within eight-tenths of a mile from the smelter. Data and statistics collected by EPA are available at: www.epa.gov/region7/cleanup/superfund/major_superfund_site_reports.html.
>
> EPA has analyzed soil samples collected through the third quarter of 2005. These samples indicate: 45 of 62 quadrants, or 73 percent, show an increasing trend in soil lead concentrations; 15 of 16 residences have at least 1 quadrant with an increasing trend of lead contamination.

4. Letter dated December 29, 2005 from the Missouri Department of Natural Resources to The Doe Run Company and copying the Herculaneum CAG, the City of Herculaneum, EPA, Missouri Attorney General's Office, and the Missouri Department of Health and Senior Services (*see* **Tab 6**). The letter cites EPA's lead recontamination data and states:

> In January 2005, the DNR completed its report entitled "Analysis of Lead Recontamination and Deposition in Soils Adjacent to The Doe Run Company's Herculaneum Smelter, Herculaneum, Missouri." This report documented the DNR's statistical analysis of lead re-deposition data from periodic soil sampling and analysis conducted in Herculaneum by the EPA. Since the report was completed, the DNR has periodically updated and refined its analysis of the EPA's re-deposition data upon receipt of new data. These statistical analyses of the re-deposition data indicate significant residential soil recontamination is occurring within 0.75 mile of Doe Run's Herculaneum smelter. Our analysis indicate residential soils within the Herculaneum VPPP area and areas beyond will be recontaminated to unacceptable levels within relatively short periods of time. Soil recontamination at these rates is an unacceptable and unsustainable long-term outcome for the Herculaneum community.

5. Letter dated December 23, 2005 from the Missouri Department of Natural Resources to The Doe Run Company, and copying the Herculaneum CAG, the City of Herculaneum, EPA, Missouri Attorney General's Office, and the Missouri

Department of Health and Senior Services (*see* **Tab 7**). The letter cites EPA's lead recontamination data and concludes:

> Based on our soil re-deposition data analyses, the DNR does not agree that general re-occupancy of residences in the Herculaneum VPPP area is protective of human health in the long-term without continued response actions. Under current conditions, on average, residential yards within one-quarter mile of the smelter would require additional clean-up in a little over two years, and would required continued remediation every 5 to 7 years, based on an action level of 400 mg/kg lead in soil. The frequency of clean up needed to continue the use of this area as residential is unsustainable and unacceptable to the DNR.

6. *EPA Fact Sheet: Herculaneum Lead Smelter Site - Herculaneum, Missouri* (November 2005, available at http://www.epa.gov/Region7/news_events/factsheets/fs_herculaneum_lead_smelter_herculaneum_mo1105.htm, last visited October 19, 2006; *see* **Tab 8**). This fact sheet states:

> Monitoring for lead recontamination in surface soils is being conducted by EPA every three months. The data indicate that lead levels are trending upward in areas within eight-tenths of a mile from the smelter. Data and statistics collected by EPA are available on EPA website: http://www.epa.gov/region7/cleanup/superfund/major_superfund_site_reports.html.

7. *EPA Fact Sheet: Administrative Record & Engineering Evaluation/Cost Analysis Report Released for Public Comment, Herculaneum Lead Smelter Site, Herculaneum, Missouri* (March 2005, available at http://www.epa.gov/Region7/news_events/factsheets/fs_admrec_eng_analy_pub_herculaneum_mo0305.htm, last visited October 19, 2006; *see* **Tab 9**). This fact sheet states:

> Monitoring for redeposition of lead in surface soils is being conducted by EPA every three months. The data is indicating that lead levels are trending upward in areas within a half mile of the smelter. EPA is conducting a study to determine the source(s) of the lead and will continue the quarterly monitoring program. Completion of the study is anticipated this summer.

Other documents relevant to this RFC are attached hereto:

- *Quality Assurance Project Plan for a Site Characterization at the Herculaneum Lead Smelter, Herculaneum, Missouri*, prepared by US EPA Region 7 Superfund

Technical Assistance and Response Team, September 10, 2001. ("2001 QAPP"; *see* **Tab 10**).[3]

- *Addendum to the Quality Assurance Project Plan for Site Characterization for the Herculaneum Lead Smelter Superfund Site*, August 30, 2006. (*See* **Tab 11**).
- *Quality Assurance Project Plan for Lead Deposition at Herculaneum, Missouri*, August, 2002. ("2002 QAPP"; *see* **Tab 12**).

III. DISCUSSION OF THE INFORMATION'S NONCOMPLIANCE WITH THE DQA AND EPA GUIDELINES

The seven numbered documents listed above do not comply with the DQA and EPA Information Quality Guidelines because they rely on lead recontamination data collected in violation of the requirements of the EPA Quality Manual. EPA Order 5360.1 A2 (May 5, 2005, available at http:// www.epa.gov/quality/qs-docs/5360-1.pdf) and Section 4 of the EPA Information Quality Guidelines state that "Agency policy has required participation in an Agency-wide Quality System by all EPA organizations (office, region, national center or laboratory) supporting environmental programs" and mandate adherence to the EPA Quality Manual.

In its actions relating to soil screening at HLS, EPA has and continues to act contrary to the EPA Quality Manual in at least three significant ways. These violations call into serious question the quality of the data used to support the assertions made in the seven HLS-related documents disseminated to the public. Specifically, the violations include the following:

1. EPA has ignored or abandoned a more recent and specific QAPP dated August 2002 in favor of an older QAPP dated September 2001 without justification and without adhering to the requirements of the EPA Quality Manual;
2. EPA has failed to properly implement either the 2001 or 2002 QAPPs by disregarding the specifications and procedures provided in the QAPPs; and
3. EPA's *ex post facto* amendment of the 2001 QAPP is in direct violation of QAPP revision procedures specified in the EPA Quality Manual.

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[3] Making data quality concerns even worse, at least two, substantively different, versions of the 2001 QAPP appear to be in circulation. The official version, which is part of EPA's *Community Soil Cleanup Plan for the Doe Run Company Herculaneum Smelter, Herculaneum, Missouri* (January 4, 2002), bears signatures dated September 11, 2001 and September 12, 2001. (**Tab 10**). Recently, Region 7 made available a divergent version of the 2001 QAPP, which bears signatures dated September 11, 2001 and October 1, 2001. (**Tab 13**). It also contains additional provisions that do not appear in the official version circulated as part of the 2002 Community Soil Cleanup Plan. This may be a separate violation of the EPA Quality Manual's requirement that all implementing personnel be provided with a copy of the QAPP and be made to understand the requirements. (EPA Quality Manual § 5.2.2).

A. EPA ignored or abandoned the 2002 QAPP without justification

EPA has contravened Section 5.2.2 of the EPA Quality Manual, which requires that "[a]ll QAPPs shall be implemented as approved by EPA," by failing to implement the 2002 QAPP when conducting the HLS lead recontamination study. Instead, EPA staff assert they are following the prior and less specific 2001 QAPP.

According to EPA's October 6, 2003 Focus Group Report, the disregard or abandonment of the 2002 QAPP occurred because the 2002 lead recontamination study results showed that "[b]ased on a review of the post-intervention soil monitoring protocol, there does not appear to be any evidence that the replaced soil is becoming contaminated during the first year since soil replacement." This finding of no lead recontamination prompted EPA staff unilaterally to change the "post-intervention soil monitoring protocol," switching from a one-inch sample depth to one-quarter or one-eighth-inch deep surface scrapings; as the Focus Group Report memorialized, "[s]urface scraping samples are a more sensitive indicator of contamination of the replaced soil by lead dust and were instituted by the EPA in Herculaneum in 2003." (Focus Group Report, **Tab 1**, p. 11).

1. Description of Violation

EPA developed two QAPPs for use at HLS, a 2001 QAPP for site characterization and a 2002 QAPP for assessing lead recontamination. The 2001 QAPP states as its objective, "[t]his QAPP was prepared to address *site characterization* to determine the extent of soil contamination caused by operations at the Herculaneum Lead Smelter (HLS) site in Herculaneum, Missouri." (2001 QAPP § 1.2, emphasis added). The soil characterization work conducted under the 2001 QAPP resulted in the remediation and replacement of the top twelve inches of soil from residential yards near HLS.

In contrast, the 2002 QAPP includes the following specific objectives: "(1) [to] determine if properties that have been cleaned under the soil removal program will be *recontaminated* by lead depositing from air to the extent (400 ppm or greater in top 1 in.) that they must be recleaned; (2) determine the rate of *recontamination* of soils by atmospheric deposition." (2002 QAPP § 2, emphasis added).

Despite these clearly articulated and differing objectives, EPA staff now contend the 2002 QAPP was meant only for "experimental" purposes and does not apply to the ongoing lead recontamination study. Instead, EPA staff assert that the 2001 QAPP applies and that they have been using the QAPP for measuring lead recontamination at HLS. This position cannot be squared with the EPA Quality Manual because there is no provision in the 2002 QAPP that states the QAPP is experimental, nor does the 2001 QAPP say that it applies to assessing lead *recontamination*. Moreover, EPA has taken no formal action to withdraw the 2002 QAPP or modify the 2001 QAPP to apply it to lead recontamination. Without such action, the 2002 QAPP remains controlling as to determining soil recontamination, and EPA's disregard or abandonment of the 2002 QAPP in favor of the 2001 QAPP is improper under the EPA Quality Manual's requirement for EPA to implement the QAPP as written (EPA Quality Manual § 5.2.2).

2. Proposed Corrective Action and Effect

Doe Run urges that EPA be directed to conduct the ongoing lead recontamination study under the terms of the 2002 QAPP. Doe Run questions whether there is a material difference in the key language of the 2001 and 2002 QAPPs, but EPA staff contend that the two QAPPs define soil sampling depths differently. The 2001 QAPP specifies that soil samples should be collected from the "upper 1 inch of soil" (2001 QAPP § 2.1), whereas the 2002 QAPP uses the term "top 1 inch" (2002 QAPP § 2). Doe Run believes the two terms are synonymous and mean the sample should be taken from the entire top one inch of surface soil. However, EPA staff distinguish "upper 1 inch" from "top 1 inch" by saying "upper 1 inch" allows the collection of soil samples using any part of the soil within the top inch and not necessarily the entire top one inch of soil (or rough equivalent, consistent with practice in the field). The effect of sampling anything less than the full one inch of soil is to make the test for lead recontamination more sensitive than intended by the QAPPs, according to the Focus Group Report. So long as EPA continues to maintain there is a distinction between the two terms, Doe Run requests that EPA be directed to follow the 2002 QAPP as required by the EPA Quality Manual, since the 2002 QAPP explicitly states that it is to be used to determine soil "recontamination."

B. EPA failed to properly implement either the 2001 or 2002 QAPPs

Further, EPA has violated another provision of Section 5.2.2 of the EPA Quality Manual, which requires that "[a]ll QAPPs shall be implemented as approved by EPA," by failing to implement soil sampling procedures as stated in the 2001 and 2002 QAPPs when conducting the HLS lead recontamination study.

1. Description of Violation

The 2001 QAPP specifies that the "composite sample will be collected from the upper 1 inch of soil." (2001 QAPP § 2.1). Similarly, the 2002 QAPP states it is intended to "[d]etermine the rate of recontamination of soils by atmospheric deposition. That is, how much lead is being deposited per kg of soil (top 1 in.) per unit time." (2002 QAPP § 2). Plainly, at the outset, EPA staff interpreted whichever QAPP they thought they were implementing to mean they needed to use a one-inch deep sample, since the "post-intervention soil protocol" at that depth failed to produce evidence of soil recontamination and had to be changed to a "surface scraping" in 2003. (Focus Group Report, **Tab 1**, p. 11). Equally clearly, EPA is now sampling only the top one-quarter to one-eighth-inch of soil or a surface scraping – contrary to the 2001 and 2002 QAPPs as written and originally implemented. Yet, despite this substantial change in practice, neither the 2001 nor 2002 QAPP was amended in a manner consistent with the EPA Quality Manual.

2. Proposed Corrective Action and Effect

Doe Run proposes that EPA should adhere to its stated QAPP sampling depth of one inch,[4] until and unless there has been shown to be an adequate and demonstrated basis for the change and full adherence to DQA requirements. EPA should reconsider any regulatory decisions it has made based on the compromised data. In addition, EPA should issue notification to the public and cease disseminating data collected under the soil scraping sampling method until and unless a scientific review can be undertaken of which approach is the more valid for determining recontamination. Doe Run should be included as a stakeholder in any process that might lead to a change in EPA's established standards under the 2001 and 2002 QAPPs.

C. EPA's *ex post facto* amendment of the 2001 QAPP violates EPA Guidelines

EPA further violated Quality Manual procedures for amending QAPPs (EPA Quality Manual § 5.2.2) when it amended the 2001 QAPP long after the fact to "clarify" soil sampling depths.

1. Description of Violation

When EPA decided to disregard the one inch sampling standard established by the 2001 and 2002 QAPPs, it failed to consult or inform Doe Run, a major stakeholder. It was not until some time later, in March 2004, that Doe Run Company became aware of EPA's change in its established sampling standards; and Doe Run immediately objected. Doe Run has continued to object to this unilateral change, from 2004 to the present. After Doe Run brought its objections to the attention of OSWER Headquarters staff in June 2006, EPA issued an "Addendum to the Quality Assurance Project Plan on August 30, 2006," some three years after the actual change EPA made in its sampling approach. Notably, the "Addendum" was made to the 2001 QAPP, which by its terms address site characterization, rather than to the more recent and more specific

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[4] In discussion with EPA staff, Doe Run cited many written examples in which EPA specified use of a one-inch sampling depth including: (1) Work Plan for Viburnum Trend Haul Roads Site (July 11, 2005), "At each aliquot location, a small area will be excavated down to approximately 1 inch into the topsoil."; (2) Work Plan for Interim Action, St. Francois County Mine Tailings Sites (May 2004), "At each aliquot location, a small area will be excavated with a clean trowel or trier down to approximately 1 inch into the topsoil."; (3) Work Plan for Removal Preliminary Assessment and Site Inspection (Viburnum Site) (EPA-approved draft dated November 10, 2005), "At each aliquot location, a small area will be excavated down to approximately 1 inch into the topsoil."; and (4) Omaha - Region VII contractor Black & Veatch, Field Sampling Plan (October 1998), "Each aliquot will be collected from the top one-inch of soil away from the influences of the house's drip zone." In response, EPA's Headquarters staff surprisingly stated that they believe these specifications and others may be widely disregarded as well. This would suggest additional DQA violations with respect to numerous other sites within Region VII (and perhaps other regions as well).

2002 QAPP which by its terms EPA explicitly adopted to examine the question of recontamination. In any event, the August 2006 amendment of the 2001 QAPP, long after Region 7 switched from a one-inch deep sample to a "surface scraping," is equally in conflict with requirements set forth in the Quality Manual with respect to both the 2001 and 2002 QAPPs.

EPA did not comply with Quality Manual requirements for revising QAPPs to make this amendment. Specifically, with regard to changes to QAPPs, the Quality Manual states:

> Because of the complex and diverse nature of environmental data operations, changes to original plans are often needed. The EPA Project Manager, with the assistance of the QA Manager as appropriate, must determine the impact of such changes on the technical and quality objectives of the project. When a substantive change is warranted, the originator of the QAPP shall modify the QAPP to document the change and submit the revision for approval by the same authorities that performed the original review. Only after the revision has been approved and received (at least verbally with written follow-up) by project personnel, shall the change be implemented. [EPA Quality Manual § 5.2.2.]

Section 5.2.2. of the Quality Manual requires that amendments be approved *before* the change takes place. In this case, EPA sought to memorialize the change *ex post facto* in 2006, long after having made the switch in sampling procedure in 2003. Moreover, the EPA Project Manager has an affirmative duty under EPA Quality Manual § 5.2.2 to review the QAPP annually and propose changes as necessary, yet did not propose any changes for more than three years. In addition, EPA provided no analysis of the change's impact on the "technical and quality objectives of the project."

The EPA Quality Manual states that quality planning "is an absolutely essential component of project management and the QAPP provides the mechanism for documenting the results of the planning process. This planning must include the 'stakeholders' (*i.e.*, the data users, data producers, decision makers, etc.) to ensure that all needs are defined adequately at the outset and that the planning for quality addresses the specific needs defined." (EPA Quality Manual § 5.1). As discussed above, EPA did not consult with Doe Run, a major stakeholder.

2. Proposed Corrective Action and Effect

Doe Run urges EPA to invalidate the 2006 Addendum to the 2001 QAPP and adhere to its established QAPP sampling depth of one inch, until and unless there has been shown to be an adequate and demonstrated basis for the change favored by EPA staff. EPA should reconsider any regulatory decisions it has made based on the compromised data. In addition, EPA should issue notification to the public and cease disseminating data collected under the soil scraping sampling method until and unless a scientific review can be undertaken of which approach is the more valid for determining recontamination. Doe Run should be included as a stakeholder in any process that might lead to change of EPA's established QAPP standards.

Adherence to EPA's promulgated procedures for establishing, implementing and amending a QAPP will maintain the credibility of EPA's sampling programs and results. It will also assist the public, elected officials and Doe Run in assessing and acting upon the results of sampling that is conducted in a manner consistent with good scientific practice, transparency and objectivity so as to maximize its usefulness for protecting public health. The blatant disregard of EPA's data quality requirements and established procedures that has occurred with respect to the HLS site should not be tolerated by the Agency and must be corrected promptly, as required by the DQA.

Respectfully submitted,

Khouane Ditthavong

Khouane Ditthavong

KD

Enclosures

~~TAB 1~~

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
901 NORTH 5TH STREET
KANSAS CITY, KANSAS 66101

14 MAY 2007

Khouane Ditthavong, Esq.
King & Spalding, LLP
1700 Pennsylvania Avenue, N.W.
Washington, D.C. 20006

Re: Request for Correction (RFC) regarding EPA's Dissemination of Information with respect to the Doe Run Herculaneum Lead Smelter Site, Herculaneum, Missouri (RFC #07001)

RFC Response

Dear Mr. Ditthavong:

This letter is in response to your Request for Correction (RFC), on behalf of The Doe Run Company (Doe Run), dated October 19, 2006, and received by the U.S. Environmental Protection Agency (EPA), pursuant to the *Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by the Environmental Protection Agency* (EPA Guidelines). Your request cites a number of concerns with EPA's soil recontamination data for the Herculaneum Lead Smelter Site (Site) in Herculaneum, Missouri. Specifically, you state that the soil recontamination data does not comply with the EPA Guidelines, the EPA Quality Manual 5360 A1 (May 5, 2000), or the EPA Order 5360.1 A2 (May 5, 2000), because the data were not collected in accordance with the appropriate Quality Assurance Project Plan (QAPP), and that EPA improperly changed its soil sampling procedures at the Site.

EPA's soil recontamination data for the Site is periodically analyzed for statistical trends, and the analysis is posted on EPA's website. In consideration of the specific concerns raised in your letter, EPA conducted a thorough review of the QA and sampling procedures associated with the soil recontamination data for the Site. Based on this review, EPA acknowledges that there are documents in the record which may cause confusion as to the soil sampling collection procedures utilized by EPA. This response seeks to eliminate any confusion and describes EPA's plans to clarify certain documents at issue. EPA wants to confirm, however, that the soil recontamination data was, and still is being properly collected consistent with the procedures described in the *Quality Assurance Project Plan for a Site Characterization at the Herculaneum Lead Smelter*[1] (2001 QAPP).

[1] Quality Assurance Project Plan for a Site Characterization at the Herculaneum Lead Smelter. EPA, September 2001.

Background

In accordance with EPA Order 5360.1 A2, the EPA Quality Manual and the EPA Region 7 Quality Management Plan, Revision No. 2 (August 21, 2001), the Region prepares a Quality Assurance Project Plan (QAPP) for activities performed by or for the Region that involve environmental data generation or use. All QAPPs for the Site were prepared in accordance with *EPA Requirements for QA Project Plans*, EPA QA/R-5 (March 2001), and approved by the EPA project manager and the Regional QA Manager or their designee, prior to the initiation of the environmental data generation or use activity.

Soil data collected by EPA at the Site is collected in accordance with the 2001 QAPP.[2] The 2001 QAPP was originally developed for purposes of performing characterization of soils at the Site, and oversight of Doe Run's soil characterization and excavation activities pursuant to an Administrative Order on Consent (AOC).[3] In February 2002, EPA determined it was also appropriate to use the 2001 QAPP for purposes of collecting soil samples to determine whether recontamination of residential yard soils with lead may be occurring.

2001 QAPP

The 2001 QAPP specifies that surface soil samples "will be collected from the upper 1 inch of soil" with a clean, dedicated stainless steel spoon. No measuring device is used or required during sample collection; therefore samples are collected from the upper portion of the 1 inch soil horizon, so as to ensure that a depth of 1 inch is not exceeded. Pursuant to the AOC, Doe Run also follows the 2001 QAPP for purposes of soil characterization at the Site and collects samples in the same manner, with no measuring device.

It is to be noted that the 2001 QAPP envisions collection of soil samples from the upper inch of soil; it does not specify where, within that upper inch, the sample is to be collected. Since implementation of the QAPP, EPA has not altered the manner in which it has collected soil samples at the Site, whether for purposes of soil characterization or soil recontamination monitoring, despite any statements that suggest otherwise in the *Technical Report for Focus Group Recommendations, Herculaneum, MO*, October 6, 2003 (Focus Group Report). To clarify confusion that has been caused by the Focus Group Report, a memorandum has been added, upon release of this response to you, to the Site File and Administrative Record. This memorandum responds to inaccurate statements in the Focus Group Report. All future EPA disseminations of the Focus Group Report will include this memorandum. A copy of this memorandum is enclosed.

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[2] Your request notes the existence of more than one version of the 2001 QAPP, bearing signature pages dated in September 2001 and October 2001. However, the two versions of the 2001 QAPP do not differ in regard to sample depth or collection methodology.

[3] Administrative Order of Consent, Docket No. RCRA-7-2000-0018 and CERCLA-7-2000-0029 (AOC).

On August 30, 2006, EPA issued an addendum to the 2001 QAPP, for purposes of clarifying the sample collection methodology EPA has consistently implemented at the Site. This addendum was issued in response to questions by Doe Run regarding sample collection methodology by EPA and Doe Run under the 2001 QAPP and AOC. The addendum, which has inadvertently contributed to further confusion rather than clarification, in fact did not modify or change what was already being implemented in practice by EPA pursuant to the 2001 QAPP since its inception. A new memorandum, upon release of this response to you, has been added to the docket. All future disseminations of the 2001 QAPP will include a dissemination of this clarifying memorandum. A copy of this memorandum is enclosed.

2002 QAPP

In August 2002, EPA developed a *Quality Assurance Project Plan for Lead Deposition at Herculaneum, Missouri* (2002 QAPP). The stated purpose of the 2002 QAPP is to assess whether recontamination is occurring at the Site. Part of this assessment includes recontamination monitoring, using composite surface soil samples, to observe what is occurring in excavated surface soils at varying distances and directions from the smelter. The 2002 QAPP did not replace the 2001 QAPP, but instead memorializes this soil sampling plan and describes additional techniques, namely air monitoring and soil boxes, to be used in conjunction with the soil sampling to evaluate deposition rates from smelter operations. The methods for soil sampling remain as specified in the 2001 QAPP, which was included as an addendum to the 2002 QAPP. The additional monitoring techniques described in the 2002 QAPP were later discontinued. Preparation of the 2002 QAPP to address the sampling plan and additional monitoring techniques does not invalidate or otherwise affect the previous 2001 QAPP sampling procedures. EPA intended for the procedure used for recontamination sampling of surface soil to be the same as that used for characterization sampling of surface soil. This was done to provide consistency between soil recontamination monitoring data and data to be used in risk assessment and soil excavation decisions for the site.

In addition, you note statements in the 2002 QAPP regarding the "top 1 in. of soil". These statements refer to how the rate of soil recontamination would be expressed using modeling techniques, and were not intended to modify the sample collection methodology.

Conclusion

Based upon the above analysis, I have concluded that the methodology used to obtain soil recontamination data is consistent with EPA's objectives of quality, objectivity, utility, and integrity. Therefore, no corrections to the data obtained from that methodology are warranted, however, as noted above, EPA has implemented the following steps to clarify any potentially confusing statements in the documents noted:

1. EPA has issued a memorandum to respond to inaccurate statements in the Focus Group Report which suggest that EPA instituted a change in its surface soil sampling methodology.

2. EPA has issued an addendum to the 2001 QAPP to supersede the August 2006 addendum, and to clarify that in practice, and since inception of the 2001 QAPP, EPA's soil samples have been collected from the upper portion of the 1 inch soil horizon so as to ensure that a depth of 1 inch is not exceeded.

Thank you for alerting EPA to your concerns. We will continue to work with Doe Run on implementation of the AOC and other matters that relate to the Site.

If you are dissatisfied with this decision, you may submit a Request for Reconsideration (RFR). The EPA requests that any such RFR be submitted within 90 days of the date of EPA's response. If you choose to submit a RFR, please send a written request to the EPA Information Quality Guidelines Processing Staff via mail (Information Quality Guidelines Processing Staff, Mail Code 2811R, U.S. EPA, 1200 Pennsylvania Avenue, N.W., Washington, D.C. 20460); electronic mail (quality@epa.gov); or fax [(202) 565-2441]. If you submit a RFR, please reference the request number assigned to the original Request for Correction (RFC #07001). Additional information about how to submit a RFR is listed on the EPA Information Quality Guidelines website at www.epa.gov/quality/informationguidelines. Please contact Dana Skelley at (913) 551-7923, should you have any questions about this response.

Sincerely,

John B. Askew
Regional Administrator

Enclosure

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
901 NORTH 5TH STREET
KANSAS CITY, KANSAS 66101

MAY 0 9 2007

MEMORANDUM

SUBJECT: Response to Focus Group Report Statements
Herculaneum Lead Smelter Site

FROM: Bruce Morrison, Project Manager
SUPR/FFSE

TO: Site File and Administrative Record

Memorandum FGR

The *Technical Report for Focus Group Recommendations, Herculaneum, MO*, dated October 6, 2003 (Focus Group Report), was prepared by Dr. C. Scott Clark from the University of Cincinnati and Dr. David A. Sterling from Saint Louis University and funded by the Environmental Protection Agency (EPA). Their report examined development of a site-specific, health-based cleanup standard and action strategy for lead dust contamination present in home interiors. As part of this process, they provided analysis of ongoing response actions to address lead contamination at the site, including review of site-specific environmental data, as well as recommendations for site-specific sampling protocols and additional actions to be taken to address interior dust.

This memorandum is being provided to respond to inaccurate statements in the Focus Group Report suggesting that EPA instituted a change in the protocol for collecting surface soil samples used to evaluate potential lead recontamination. The Focus Group Report indicated that EPA's surface soil samples were collected by sampling the top one-inch soil horizon, and that EPA instituted a new surface soil scraping protocol in 2003 whereby surface soil samples were collected from less than the entire one-inch soil horizon. Specifically, the Focus Group Report states that:

> "Since soil recontamination would be initiated with the top layers of soil becoming contaminated from fallout or ground level transport of lead containing particles, the top one-inch soil lead sample would not readily reflect such contamination. Surface scraping samples are a more sensitive indicator of contamination of the replaced soil by lead dust and were instituted by the EPA in Herculaneum during 2003. We did not have the opportunity to review the additional surface soil sampling data and so cannot comment on those results. If a written protocol is not yet prepared, a protocol for a soil-scraping sample is available in the Protocol from the Three City Urban Soil-Lead Abatement Demonstration Project (EPA 1993)."

In actuality, the EPA did not institute any changes in its surface soil sample collection protocol. Consistent with the September 10, 2001, Quality Assurance Project Plan (QAPP) for the Site, surface soil samples had always been collected from the upper portion of the one-inch soil horizon so as to ensure that a depth of one inch was not exceeded because exact measuring devices are not used when collecting sample aliquots. At the time of the Focus Group Report, EPA evaluated its surface soil sample collection protocol and concluded it was appropriate for use in investigating the potential recontamination of surface soil. The EPA continues to collect surface soil samples at the Herculaneum Lead Smelter Site from the upper portion of the one-inch soil horizon, consistent with the September 10, 2001, QAPP for the Site.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
901 NORTH 5TH STREET
KANSAS CITY, KANSAS 66101

MAY 0 9 2007

MEMORANDUM

SUBJECT: Addendum to the Quality Assurance Project Plan (QAPP) for Site Characterization for the Herculaneum Lead Smelter Superfund Site

FROM: Bruce A. Morrison, RPM
SUPR/FFSE

TO: EPA Quality Assurance Branch

Addendum 2007

This Memorandum is intended to supersede the previous addendum approved on September 5, 2006.

At the Herculaneum Lead Smelter Superfund Site surface soil samples are collected in accordance with the September 10, 2001, Quality Assurance Project Plan which states that samples are to "be collected from the upper 1 inch of soil". In practice, since the inception of the 2001 QAPP, EPA's samples are collected from the upper portion of the 1 inch soil horizon so as to ensure that a depth of 1 inch is not exceeded because exact measuring devices are not used when collecting sample aliquots.

QUALITY ASSURANCE PROJECT PLAN

FOR A

SITE CHARACTERIZATION AT THE
HERCULANEUM LEAD SMELTER

HERCULANEUM, MISSOURI
CERCLIS ID NO.: MOD006266373

Prepared For:

U.S. Environmental Protection Agency Region VII
Superfund Division
901 North 5th Street
Kansas City, Kansas 66101

Prepared By:

USEPA Region VII Superfund Technical Assessment and Response Team (START) 2

September 10, 2001

2001 QAPP

APPROVED BY:

START Project Manager, Ryan Schuler	9/11/01 Date
START Program Manager, Hieu Q. Vu, PE, CHMM	9/11/01 Date
EPA Project Manager, Superfund Division, Joe Davis	9-11-01 Date
Robert B. Dona EPA Superfund Quality Assurance Coordinator, Bob Dona	9/12/01 Date

Attachment 4

TABLE OF CONTENTS

ATTACHMENTS

1.0 PROJECT MANAGEMENT

1.1 DISTRIBUTION LIST

Region VII EPA	Joe Davis, USEPA Project Manager Bob Dona, USEPA SuperFund Quality Assurance Coordinator
Region VII START	Ryan Schuler, START Project Manager Hieu Q. Vu, START Program Manager Ted Faile, START Quality Assurance Manager

1.2 PROJECT/TASK ORGANIZATION/SCOPE OF WORK

Ryan Schuler, of the U.S. Environmental Protection Agency (USEPA) Region VII Superfund Technical Assessment and Response Team (START), will serve as the START Project Manager for the activities described in this Quality Assurance Project Plan (QAPP) to be conducted at the Herculaneum Lead Smelter Site in Herculaneum, Missouri. He will be responsible for overall coordination of site activities, ensuring implementation of the QAPP, and providing periodic updates to the client concerning the status of the project, as needed. Joe Davis will be the USEPA Project Manager for this activity.

Eight to ten START members will comprise the field/sampling team. The team will be responsible for assisting EPA with surveying activities, obtaining access to sampling properties, acquisition and calibration of sampling equipment, sample collection, field screening, documentation of residential property conditions and field activities, and coordination of laboratory analyses. The START Quality Assurance (QA) Manager will provide technical assistance, as needed, to ensure that necessary QA issues are adequately addressed.

This QAPP was prepared to address site characterization to determine the extent of soil contamination caused by operations at the Herculaneum Lead Smelter (HLS) site in Herculaneum, Missouri. In addition, air monitoring stations will be established to document fugitive releases of airborne contaminants. The scope of work includes obtaining property access, surveying/marking sampling cells at each property, collection of surface soil samples for field screening and laboratory analyses, and collection of ambient air samples at several locations near the HLS site.

Although an attempt will be made to adhere to this QAPP as much as possible, the proposed activities may be altered in the field if warranted by site-specific conditions and/or unforeseen hindrances that prevent any aspect of this QAPP from being implemented in a feasible manner. Such deviations will be recorded in the site logbook as necessary. This QAPP will be available to the field team(s) at all times during sampling activities to serve as a key reference for the proposed activities described herein.

1.3 PROBLEM DEFINITION/BACKGROUND/SITE DESCRIPTION

This QAPP was prepared by the Tetra Tech START to address imminent and long-term concerns that could impact human health and/or the environment at the HLS site (site), where metals-contaminated soils (predominantly lead, cadmium and zinc) have been identified during previous sampling activities.

The HLS site is located at 881 Main Street in Herculaneum, Missouri, about 25 miles south of the St. Louis metropolitan area (see Attachment A - Figure 1: Site Location Map). The site property is approximately 52 acres in size. An approximately 24-acre slag disposal pile is located south of the smelter in a horseshoe bend of Joachim Creek. The slag pile is located in the floodplain of Joachim Creek, in an area classified as a wetland. The smelter site is bordered on the east by the Mississippi River and on the north and west by residential areas. South of the smelter is the slag pile and wetland area. The slag pile is bordered to the east, west, and south by Joachim Creek, and to the north by residential areas and the smelter facility (see Attachment B - Figure 2: Aerial Photography). The slag pile and most of the smelter facility are located in Jefferson County, Section 29, T. 41 N., R.6 E., although the northern portion of the facility extends into Section 20. Geographic coordinates of the site are 38 15' 19.0" north latitude and 90 22' 56.7" west longitude.

The site is an active lead smelter, the largest of its kind in the United States. HLS began operations in 1892 as part of the St. Joseph Lead Company. In 1986, it became part of the newly formed Doe Run Company (Doe Run), a joint venture of the Fluor Corporation and the Homestake Mining Company. In 1990, the Fluor Corporation became the sole owner of Doe Run. The site consists of three main areas: (1) the smelter plant, located on the east side of Main Street; (2) the slag storage pile; and (3) office buildings on the west side of Main Street.

The following major processes occur at the HLS site: (1) sintering, smelting, and refining of lead ore;

(2) sulfuric acid production from waste sulfur-containing gases generated by the sintering operation; and (3) wastewater treatment. The smelting operation generates a molten slag, 20 percent of which is sent to a slag storage pile as waste. The slag pile occupies approximately 24 acres in the floodplain of Joachim Creek, and is up to 40 feet tall in some sections. In 1993, during a major flood event, water reached several feet up the sides of the slag pile. The site also generates stack air emissions from the smelter and fugitive air emissions from various operations (MDNR, 1999).

Several investigations have been conducted at the site, including a Preliminary Assessment/ Screening Site Inspection by the EPA in 1980, a multimedia compliance inspection by the EPA in 1995, a Preliminary Ecological Risk Assessment for Fish and Wildlife Habitats by the U.S. Fish and Wildlife Service (USFWS) in 1998, and a Preliminary Assessment by the Missouri Department of Natural Resources (MDNR) in 1998 and 1999. In addition to these state and federal lead investigations, the facility has collected and submitted to the state a large quantity of environmental data pursuant to Missouri's site-specific State Implementation Plan (SIP) established under the Clean Air Act (CAA), National Pollutant Discharge Elimination System (NPDES) permit, Metallic Minerals Waste Management Act permit, and voluntary soil cleanup efforts in the surrounding Herculaneum community.

Based on previous investigations, primary metal contaminants in the slag pile include arsenic, cadmium, copper, lead, nickel, and zinc. The slag pile has been partially inundated by flood waters in the past. The USFWS identified significant concentrations of lead, cadmium, and zinc in floodplain soils; significant concentrations of lead and zinc in river sediments; and significant zinc concentrations in surface water samples collected from drainage ditches on the Joachim Creek floodplain.

Stack and fugitive emissions from the site, and fall-out from these emissions, have resulted in releases of lead, cadmium, and sulfur dioxide to the air and soil. Since 1980, the smelter's emissions have been regulated under general and site-specific regulation established in the SIP. Lead emissions at one air monitoring station near the site have consistently been above the 1.5 microgram per cubic meter (g/m^3) National Ambient Air Quality Standard (NAAQS), since it was installed in 1992. Due to the continued noncompliance with the NAAQS standard, new SIP regulations are being developed by the site and MDNR.

Soil sampling has shown lead levels as high as 12,800 parts per million (ppm) in the surface soils of homes surrounding the smelter. A 1992 Jefferson County Health Department study identified 13 homes near the site where children had lead levels greater than 15 micrograms per decaliter (g/dl). Twelve of these 13 homes had lead levels in the soil ranging from 1,000 to 3,500 ppm, and one had lead levels in the soil up to 999 ppm. Thirteen out of 21 birds tested as part of the USFWS study showed clinical or subclinical lead poisoning based on liver analysis. Fish and tissue samples collected during this study had lead concentrations up to 7.5 ppm. Under a groundwater monitoring program conducted at the site since 1980, lead and cadmium concentrations in the groundwater periodically have been found above the respective maximum contaminant levels (MCLs) established under the Safe Drinking Water Act. The MCLs for lead and cadmium are 15 parts per billion (ppb) and 5 ppb, respectively.

In August of 2001, EPA was notified by a Herculaneum citizen of a grey powdery substance on the roads in the town. Further investigation identified the substance containing lead at 300,000 ppm or 30%. Additional field screening identified the trucks delivering lead concentrate to the Doe Run Smelter as the likely source of the material along the haul routes in the town.

1.4 PROJECT/TASK DESCRIPTION

The activities described in this QAPP will address the following:

A. The extent of soil contamination in residential yards, day-care facilities, areas in schoolyards frequented by children, parks, and all other child high-use areas affected by the HLS operations located east of and adjacent to U. S. Highway 61 and north of Joachim Creek in the township of Herculaneum. In addition, all residential yards and child high-use areas adjacent to or north of Old Route 61 Highway between the Joachim Creek overpass and U.S. Highway 61 shall be characterized. This includes all residential lots owned by the Doe Run Company and vacant residential lots.

B. If the results of the site characterization along haul routes conducted in item A above indicate that high levels of surface soil contamination exists beyond the boundaries specified, sampling will be conducted to delineate the extent of this contamination in residential yards, day-care facilities, areas in schoolyards frequented by children, parks, and all other high use areas affected by the HLS operations.

1.5 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The QA objective for this project is to provide valid data of known and documented quality. Specific Data Quality Objectives (DQO's) are discussed in terms of accuracy, precision, completeness, representativeness, and comparability.

For this project, accuracy is defined as the ratio, expressed as a percentage, of a measured value to a true or reference value. The measurement process of a contaminant concentration includes separate field and laboratory measurements. Errors are associated with each of these two types of measurements. These errors will be quantified and expressed as a measure of accuracy. The analytical component of accuracy will be expressed as Percent Recovery based on the analysis of lab-prepared spike samples and Performance Evaluation (PE) audit samples.

Precision for this project is defined as a measure of agreement among individual measurements of the same property and will be expressed via duplicate samples. The overall precision is assessed by collection of duplicate or collocated samples. Approximately 10% of duplicate/collocated samples is anticipated.

Data completeness will be expressed as the percentage of data generated that is considered valid. A completeness goal of 100% will be applied to this project; however, if that goal is not met, site decisions may still be made based on the remaining data. No specific critical samples have been identified for the project.

Representativeness of collected samples is facilitated by establishing and following criteria and procedures identified in this QAPP.

Data comparability is achieved by requiring all data generated for the project be reported in common units. The following table lists the various types of data that will be generated and the specific reporting units.

SPECIFIC DATA REPORTING UNITS	
PARAMETER	UNIT
Metals in Soil by X-ray Fluorescence Spectrometer (XRF)	ppm
Metals in Soil by Laboratory Analysis	milligrams per kilogram (mg/kg)
Metals in Air	micrograms per cubic meter (g/m^3)
Sampled Air Volume at Standard Temperature and Pressure (STP)	cubic meters at STP (m^3 STP)
Sampling Flowrate at STP	cubic meters per minute at STP (m^3/min STP)
Wind Speed	miles per hour (mph)
Wind Direction (Field Report)	degrees on an azimuth compass
Temperature	degrees Farenheit (F)
Barometric Pressure (not corrected to sea level)	millimeters of mercury (mm Hg)
Time	military time (00:00 - 24:00)
Date	month/day/year

1.6 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

All site personnel will be required to have completed a basic 40-hour health and safety (Hazardous Waste Operations and Emergency Response [HAZWOPER]) training course and annual refreshers. Familiarization with the Niton™ XRF and its operating procedures will also be necessary for the START members.

1.7 DOCUMENTATION AND RECORDS

START personnel will maintain a field logbook to record all pertinent activities associated with the sampling events. Appropriate documentation pertaining to photographs taken by START will also be recorded in the field logbook. Information pertaining to all samples (i.e., sampling dates/times, locations, etc.) collected during this event will be recorded on sample field sheets generated by START. Labels generated by START will be affixed to sample containers, identifying sample numbers, dates collected, and requested analyses. Chain of custody records will be completed/maintained for all samples from the time of their collection until they are submitted to the laboratory for analysis.

A health and safety plan will be prepared by START prior to the field activities that will address site-specific hazards. The health and safety plan will be reviewed and signed by all field personnel prior to field work, indicating that they understand the plan and its requirements. Copies of the plan will be available to all personnel throughout the sampling activities.

2.0 MEASUREMENT/DATA ACQUISITION

2.1 SAMPLING PROCESS DESIGN

The proposed sampling scheme for this project will be in accordance with the Removal Program Representative Sampling Guidance, Volume 1: Soil, OSWER Directive 9360.4-10, November 1991, and judgmental (based on the best professional judgement of the sampling team). The sampling design proposed in the following paragraphs has been selected to identify the extent of soil contamination at the site. The proposed number of samples is a balance between cost and coverage and represents a reasonable attempt to meet the study objectives while staying within the budget constraints of a typical site investigation.

The characterization sampling will be conducted in a priority hierarchy as follows:

1. Residential yards where a known child under 7 years old resides.
2. Residential yards along the primary and secondary concentrate haul routes.
3. Child high use areas.

At a minimum, residential properties located in the previously identified area will have four quadrants established around the home, which will radiate out 50 feet from each side of the home. In each quadrant, a nine-aliquot composite sample will be collected from the upper 1 inch of soil and screened with a Niton™ XRF. Therefore, a minimum of 4 four samples will be collected from each resedential property. Soil samples will not be collected from within 3 feet of the residential dwellings to reduce the potential lead-based paint contribution to soil-lead concentrations. In addition, multi-aliquot surface soil samples will be taken at the drip line of each structure where a child under 6 years old with elevated blood lead is known to reside. Multi-aliquot surface soil samples will also be collected from any play areas, gardens, sand piles, unpaved driveways, and other areas appearing to be frequented by children. The number of aliquots for these areas will be dependent upon size, but, in general, will follow the aliquot density used for the quadrants.

A 9-aliquot soil sample will be collected from the five-foot section of residential yards and high child use areas adjacent to roads used as haul routes by the Doe Run Company and within the first 50 yards of the streets intersecting with those haul routes.

In addition to soil sampling at residential properties, indoor dust samples will be collected at residential homes which meet the one of the following criteria: 1) homes which have a child less than 6 years of age; and 2) homes which have an XRF screening concentration of greater than 10,000 ppm from any area of the yard.

For locations where there are no residences, a center point, depicting a possible future building site, will be established and flagged. From the center point, four quadrants will be established, which will radiate out 100 feet in each compass direction, and the aforementioned sampling protocols will be completed (e.g. collecting a nine-aliquot composite from each quadrant).

If the results of the screening characterization conducted indicate that surface soil contamination exists (i.e., lead concentrations greater than 400 ppm) beyond the specified limits, further sampling will be conducted on properties beyond the defined sampling.

In addition to soil sampling, four to five ambient air sampling apparatus will be established at several locations near the smelter to determine the potential impact of transporting lead materials from and to the smelter. Specific monitoring locations will be based on field judgment. The monitoring locations will include high traffic and low traffic areas, in order to study any differences. The sampling apparatus will include Hi-Vol and PM-10 Hi-Vol air monitoring instruments. The air monitoring instruments will be placed on the ground. At least one Hi-Vol and one PM-10 Hi-Vol will be collocated at one location.

A summary of anticipated samples to be collected for this project is provided in the following table. The exact number will depend on field screening results, as previously described. Approximately 10 percent of all screening samples will be collected for laboratory confirmation analysis.

Matrix	Number of Samples		Laboratory Analyses[1]
	Field Screening (Lead)	Laboratory	
Soil	4000	400	Lead, cadmium, arsenic, zinc, nickel
Dust	NA	250	Lead, cadmium, arsenic, zinc, nickel
Air	NA	200	Lead, cadmium, arsenic, zinc, nickel

NA = Not Applicable
[1] See Section 2.4 for details pertaining to analyses.

2.2 SAMPLING METHODS REQUIREMENTS

Soil samples will be collected following the EPA Region 7 SOP #2231.12A: ERT #2012; "Soil Sampling". Confirmation soil samples will be collected with a clean, dedicated stainless steel spoon and homogenized in a clean, dedicated aluminum pie pan. The samples will be screened with the XRF after homogenizing the soil, and three consecutive XRF readings will be collected. The three homogenized XRF readings will be recorded on a field sheet. Screening samples using the XRF will follow EPA Region 7 SOP # 4231.707A. The location of the XRF readings (as well as confirmation sample location, if necessary) will also be recorded on each field sheet. Confirmation samples will be transferred directly into the appropriate container for analysis. The samples will be submitted to a subcontracted laboratory.

Indoor dust sampling will be conducted in accordance with EPA Region 7 SOP #4231.11A with a minor modification to include the use of a hand-held electric vacuum sweeper. A dedicated filter will be used for each sample. The dust sample will be collected from an adequate area to provide a minimum of 5 grams of weight. The sampling area will include high traffic areas, children bedrooms, and/or undisturbed areas. Pertinent sampling information will be documented on field sheets. The dust sample will be transferred directly into a dedicated ziplock bag and labeled for laboratory analysis.

All ambient air sampling will be accomplished using Hi-Vol and PM-10 Hi-Vol Air Samplers (manufactured by General Metals Work, Inc., Village of Cleves, Ohio), or equivalent The samplers will be operated in accordance with EPA Region 7 SOP No. 2314.1A and No. 2314.2A except where procedures differ from this QAPP. In all cases, the policies described in this QAPP shall take precedence over other EPA SOPs. Each sampler will be positioned on the ground level. Suitable supporting structures meeting all local and Federal safety codes will be used. Samplers will be operated continuously for a 24-hour (±10%) sampling duration. Sampler start and completion times will be referenced to 2400 hours.

Air samples may be voided by the EPA OSC or START Project Manager under the following conditions: (1) If the sampling duration is outside the 21.6 to 26.4 hour limit; (2) evidence of sample tampering is observed; or (3) sample is known to be unrepresentative (due to contamination, sampler failure, etc.).

One meteorological station will be established for the air monitoring. The station will be sited and operated in accordance with "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV Meteorological Measurements", EPA-600/4-82-060, August 1989. Specifically, the station will measure wind direction, wind speed, and temperature from a height of 10 meters. Data logging will be accomplished electronically using an averaging time of 1 hour. Surface pressure (not corrected to sea level) will be recorded hourly. If larger scale meteorological data are required, such "synoptic" data will be acquired from the nearest US Geological Survey stream recording station or from the nearest reporting airport.

Disposal of investigation-derived wastes (IDW) and procedures for equipment/personal decontamination will be addressed in a site-specific health and safety plan prepared by the Tetra Tech START. In general, it is anticipated that most IDW will consist of disposable sampling supplies (gloves, paper towels, etc.) that will be disposed of off-site as uncontaminated debris.

2.3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Samples will be collected in accordance with procedures defined in Region VII EPA SOP 2130.4B. Chain of custody procedures will be maintained as directed by Region VII EPA SOP 2130.2A. Samples will be accepted by the contracted laboratory according to their specific procedures and SOPs.

All soil sample containers will be placed in plastic bags to control spillage in case the containers break during shipment. Soil and dust samples will be placed in coolers containing packing material and enough ice to ensure that the temperature of the samples does not exceed 4 C. Necessary paperwork for all samples, including chain of custody records, will be completed by the Tetra Tech START and maintained with the coolers until delivery to the laboratory. If shipment of the samples is required via commercial service, each cooler lid will be securely taped shut, and two custody seals will be signed/dated and placed across the lid opening. The samples will be submitted to the receiving laboratory by START personnel in a time-efficient manner to ensure that the applicable holding times are not exceeded.

2.4 ANALYTICAL METHODS REQUIREMENTS

The samples will be analyzed at a pre-qualified laboratory contracted by the Tetra Tech START, according to the EPA methods listed in the following table. Detection limits that are typically reported by those methods are expected to be adequate for this activity. The requested analyses have been selected based on past sampling data and historical information collected for the site:

ANALYTICAL METHODS	
Analytical Parameter [1]	EPA Method Number
SOIL/DUST	
Lead, cadmium, arsenic, zinc, nickel	SW846 Method 6010B
AIR	
Lead, cadmium, arsenic, zinc, nickel	SW846 Method 6010 B and 7000 Series

[1] EPA may cease the analysis for zinc and nickel content if zinc and nickel concentrations in the initial confirmation samples are consistently below MDNR's Any Use Soil Levels.

2.5 QUALITY CONTROL REQUIREMENTS

Because dedicated supplies will be used for all samples (i.e., stainless steel spoons, pie pans, etc.), no QC samples will be required to assess the potential for cross-contamination. Analytical error (precision and accuracy) will be determined by the analysis of laboratory-prepared duplicates and spike samples. These criteria, along with other laboratory QC elements, will be performed in accordance with the contract laboratory's quality assurance plan.

To satisfy the quality control elements for the XRF, data will be collected and analyzed for comparability to laboratory data, to determine detection and quantitation limits, and to determine accuracy and precision. The mean of the three XRF readings taken for each confirmation sample will be compared statistically to the laboratory results for each confirmation sample to assess comparability. The measure of agreement (r^2) for the XRF unit should be above 0.7 or greater for the XRF data to be considered screening level data.

For every measurement, the Niton™ gives an uncertainty range that represents a 95 percent confidence interval. In general, precision/accuracy increases with increasing sample run time. Due to preliminary sample results indicating high lead levels, XRF sample run time will be increased accordingly to improve precision and accuracy. The goal is for samples to be screened long enough to obtain precision measurements within 20% of the actual concentrations.

2.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

Testing, inspection, and maintenance of all sampling equipment and supplies, along with field screening instrumentation, will be performed by START personnel prior to deployment for field activities. Testing, inspection, and maintenance of analytical instrumentation will be performed in accordance with the contracted laboratory's analytical SOPs and manufacturers' recommendations.

2.7 INSTRUMENT CALIBRATION AND FREQUENCY

Calibration of the field screening and laboratory analytical instrumentation will be in accordance with the referenced SOPs and manufacturers' recommendations.

2.8 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

All sample containers will meet EPA criteria for cleaning procedures required for low-level chemical analysis. Sample containers will have Level II certifications provided by the manufacturer in accordance with pre-cleaning criteria established by EPA in *Specifications and Guidelines for Obtaining Contaminant-Free Sample Containers*. The certificates of cleanliness will be maintained in the project file.

2.9 DATA ACQUISITION REQUIREMENTS

Previous data/information pertaining to the site (including other analytical data, reports, photos, maps, etc., which are referenced in this QAPP) have been compiled by START from various sources. Some of that data has not been verified; however, that information will not be used for decision-making purposes without verification of its authenticity.

2.10 DATA MANAGEMENT

All laboratory data will be managed as specified in the contract laboratory's QAM. Preliminary data will be received by the project manager on site. The final data package will be forwarded to a chemist trained in data validation to complete the validation process. The results will be summarized and included in the report submitted to EPA.

3.0 ASSESSMENT/OVERSIGHT

3.1 ASSESSMENTS AND RESPONSE ACTIONS

Assessment and response actions pertaining to analytical phases of the project are addressed in the contracted laboratory's quality assurance manual(s). Because of the short duration of this sampling event, no field audits of sampling procedures will be performed. Corrective actions will be taken at the discretion of the EPA Project Manager, whenever there appears to be problems that could adversely affect data quality and/or resulting decisions affecting future response actions pertaining to the site.

3.2 REPORTS TO MANAGEMENT

A letter report describing the sampling techniques, locations, problems encountered (with resolutions to those problems), and interpretation of analytical results will be prepared by START, following completion of the field activities described herein and validation of laboratory data. The laboratory data for soil samples will be compared to all applicable or relevant and appropriate requirements (ARARs), including removal action levels that have been established for the site, to determine whether further response is warranted.

4.0 DATA VALIDATION AND USABILITY

4.1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

Data review and verification will be performed by a qualified laboratory analyst and the laboratory's section manager in accordance with the contracted lab's quality assurance program. Follow-up validation of the data will be performed by a Tetra Tech START chemist. The START Project Manager will be responsible for overall validation and final approval of the data, in accordance with the projected use of the results.

4.2 VALIDATION AND VERIFICATION METHODS

A qualified Tetra Tech START chemist will review the data for laboratory spikes/duplicates and laboratory blanks to ensure that they are acceptable. The START Project Manager will inspect the data to provide a final review. The START Project Manager will also compare the sample descriptions with the field sheets for consistency and will ensure that any anomalies in the data are appropriately documented.

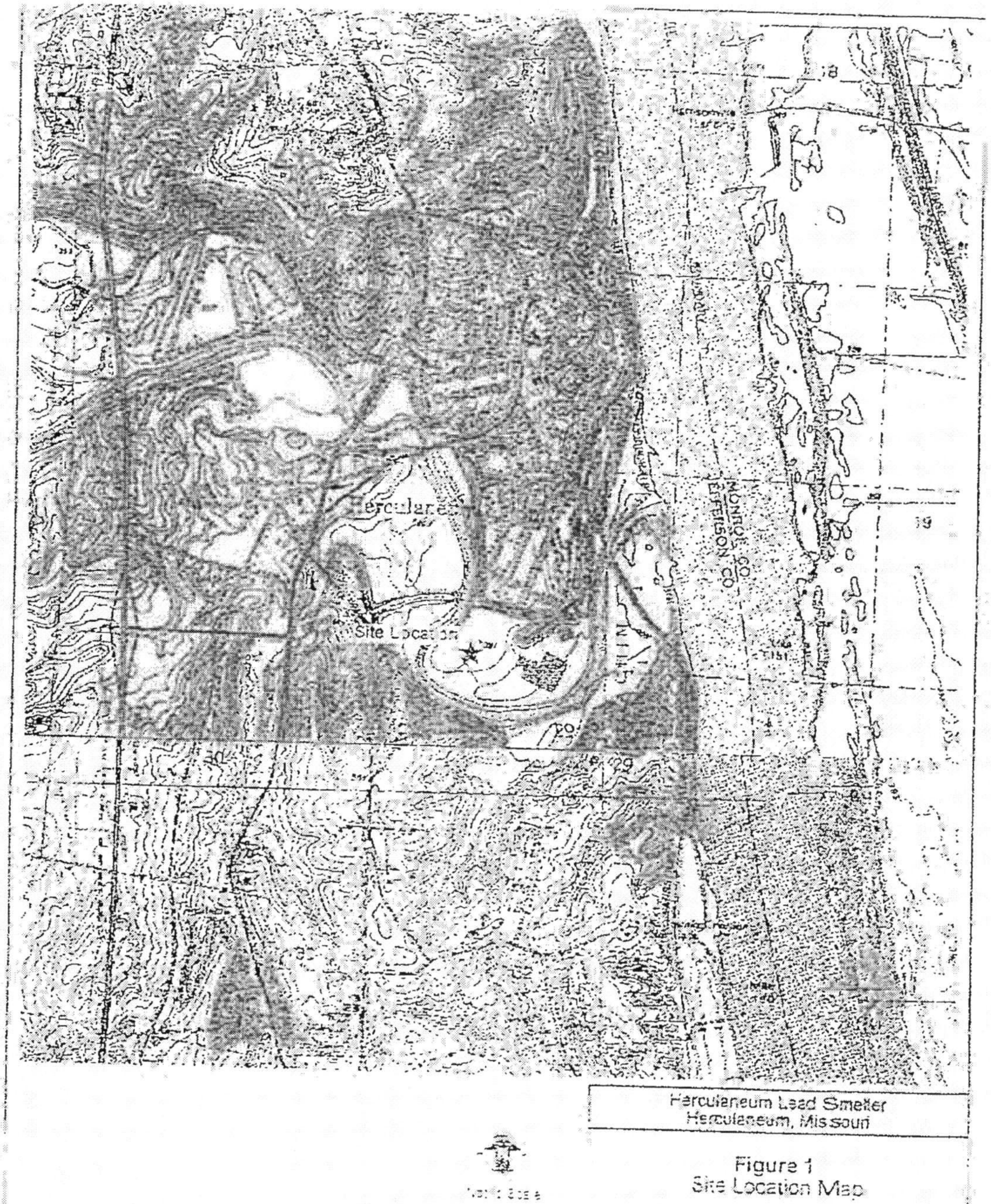
4.3 RECONCILIATION WITH USER REQUIREMENTS

If data quality indicators do not meet the project's requirements as outlined in this QAPP, the data may be discarded, and re-sampling and/or re-analysis may be required.

ATTACHMENT A

Figure 1: Site Location Map

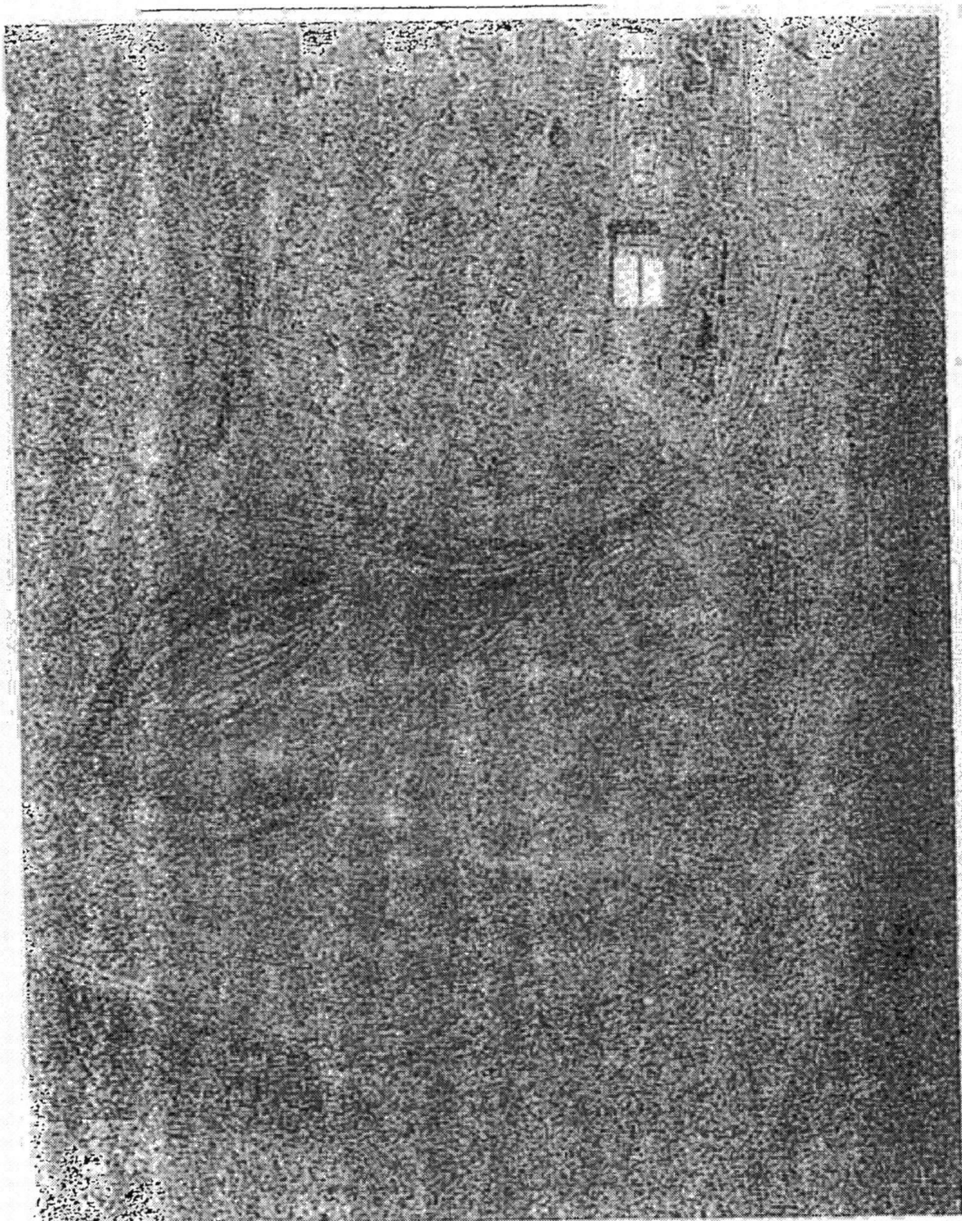
(One page)



Herculaneum Lead Smelter
Herculaneum, Missouri

Figure 1
Site Location Map

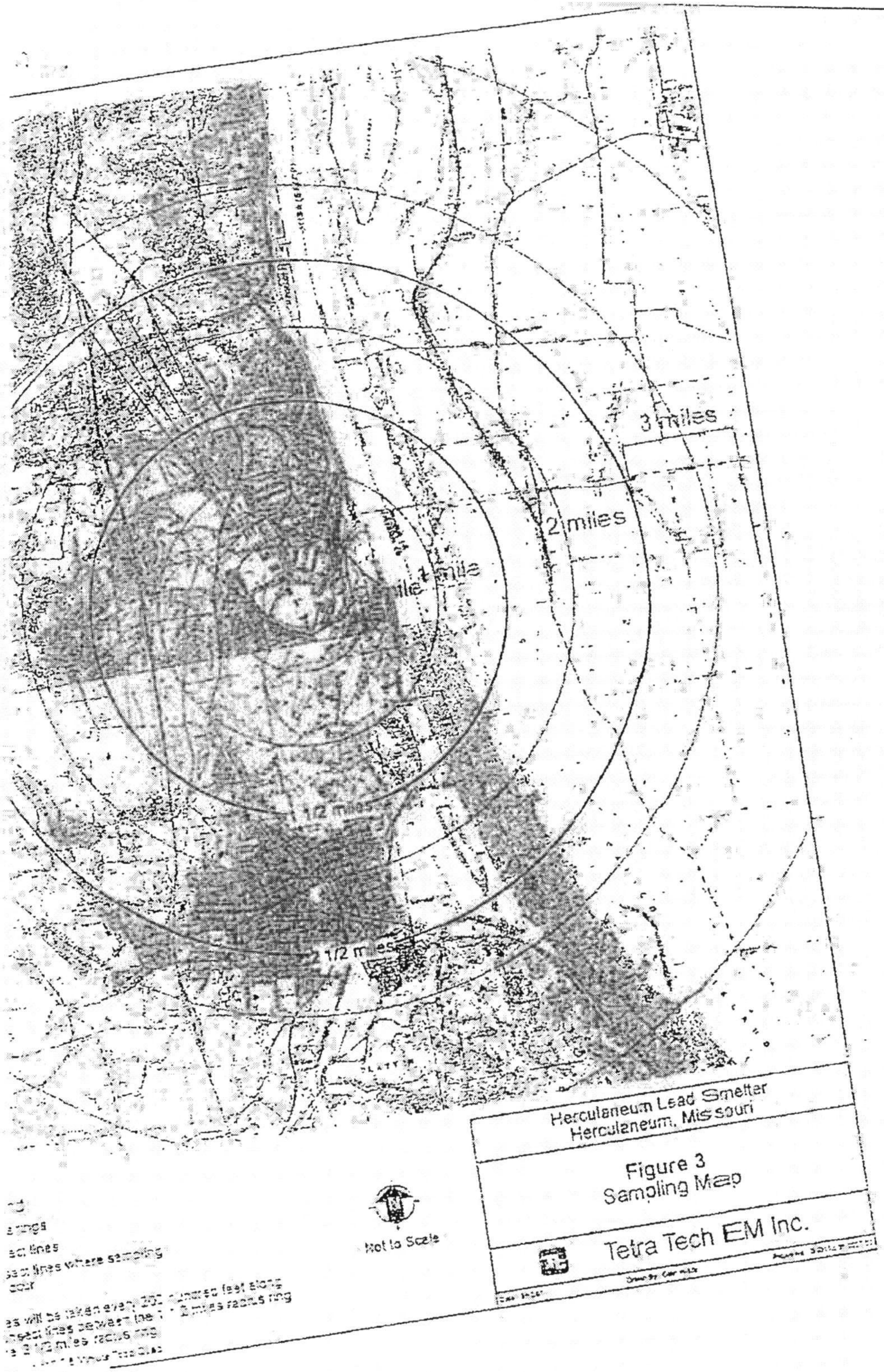
Tetra Tech EM Inc.



Herculaneum Lead Smelter
Herculaneum, Missouri

Figure 2
Aerial Photography

Tetra Tech EM Inc.



Herculaneum Lead Smelter
Herculaneum, Missouri

Figure 3
Sampling Map

Tetra Tech EM Inc.

MEMORANDUM

SUBJECT: Addendum to the Quality Assurance Project Plan for Site Characterization for the Herculaneum Lead Smelter Superfund Site

FROM: Bruce A. Morrison
Project Manager

TO: EPA Quality Assurance Branch

This Memorandum is a request for the EPA Region VII Quality Assurance Branch to review the following soil sampling clarification and attached memorandum authored by the EPA Technical Review Workgroup concerning site-specific soil sampling.

Page 7 of the attached Quality Assurance Project Plan (QAPP) states that surface soil samples will be collected from the upper 1 inch of the soil horizon. This memorandum seeks to clarify that samples will be surface soil scrapings collected from the uppermost soil horizon not to exceed 0.5 inches in depth. The rational for this shallow sampling is based on the nature of an ongoing source of lead at the site which is identified as the emissions from the lead smelter in Herculaneum. Although previous surface soil samples taken at the site have been collected from the 0.5-inch soil horizon, this memorandum is intended to identify more specifically the depth that soil samples are collected from at the site.

2001 QAPP Addendum

APPROVED BY: Bruce A. Morrison

EPA Project Manager, Bruce A. Morrison — 8/30/06 Date

Diane Harris

Quality Assurance Representative — 09/05/2006 Date

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To L. ZARAGOZA	From B. MORRISON
Co.	Co.
Dept	Phone #
Fax #	Fax #

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INEEL/EXT-02-00984

August 2002

Quality Assurance Project Plan for Lead Deposition at Herculaneum, Missouri

2002 QAPP

C. S. Staley, P. D. Ritter, and A. S. Rood

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
901 NORTH 5TH STREET
KANSAS CITY, KANSAS 66101

09 OCT 2002

MEMORANDUM

SUBJECT: Conditional Approval of QAPP for Lead Deposition at Herculaneum, Missouri

FROM: RBDona
Robert B. Dona, Superfund Quality Assurance Coordinator
SUPR/STAR

TO: Bruce Morrison, Remedial Project Manager
SUPR/FFSE

The Quality Assurance Project Plan (QAPP) for Lead Deposition at Herculaneum, Missouri dated August 2002, has been reviewed for adequacy and completeness in accordance with EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, EPA QA R-5.

Although the document satisfactorily addressed most of the key issues, a deficiency was noted. This area is fully addressed below and can be adequately addressed by incorporation without resubmission. The document would not be approved without inclusion of the recommendation.

This QAPP does not appear to contain the project-specific calculations or algorithms to be used to translate the analytical data to the decision rule of an increase of 25 ppm/year in soil lead.

If you have any questions, please call me at 913-551-7707.

Attachment: QAPP

QAC Document No. S2086

INEEL/EXT-02-00984

Quality Assurance Project Plan for Lead Deposition at Herculaneum, Missouri

C. S. Staley
P. D. Ritter
A.S. Rood

Published August 2002

Idaho National Engineering and Environmental Laboratory
Chemistry and Geosciences Department
Idaho Falls, Idaho 83415

Prepared for the
U. S. EPA National Exposure Research Laboratory, Technology Support Center,
Characterization and Monitoring Branch
and for the
U.S. Department of Energy
Assistant Secretary for Environmental Management
Under DOE Idaho Operations Office
Contract DE-AC07-99ID13727

ABSTRACT

This Quality Assurance Project Plan (QUAPP) describes the data collection activities needed to determine: 1) if lead deposition to soils from lead smelting operations is presently occurring in Herculaneum, Missouri, and if so, 2) whether deposition is occurring at a rate warranting further controls on Doe Run Company's lead smelting operations. Historic operations of the lead smelter caused high soil lead concentrations in the community, which ultimately resulted in elevated blood lead levels in 28% of children age 6 and under living in Herculaneum. As a result, numerous actions were initiated, including installation of controls on emissions from smelter processes, and excavation of contaminated soil at numerous properties (this is ongoing).

Deposition sampling will be conducted at 21 sites in and outside Herculaneum. This monitoring is in addition to the soil measurements (recontamination study) and ambient air monitoring already underway. Deposition will be monitored by three means: 1) filter paper deposition collectors, 2) field XRF measurements of soil boxes, and 3) field XRF measurements of in-situ soil.

After one year of monitoring, if lead is significantly above zero or baseline concentrations in greater than 10% of any of the sample types from any site, then further data analysis and calculations will be performed to determine the possible rate of soil recontamination. If the rate of soil recontamination for the top 1 inch of soil is determined to be greater than 25 ppm/year, then additional soil sampling and laboratory analysis will be conducted to verify the rate. If the rate cannot be verified, then further deposition monitoring is indicated. If the rate is verified at > 25 ppm/year, then further controls on smelter operations are likely necessary.

CONTENTS

FIGURES

TABLES

ACRONYMS

CAA	Clean Air Act
CERCLIS	Comprehensive Environmental Response Compensation Liability Information System
DQO	Data quality objective
EPA	Environmental Protection Agency
FPXRF	field portable X-ray fluorescence
HEPA	high efficiency particulate air
HLS	Herculaneum Lead Smelter
ICP/MS	inductively-coupled plasma/mass spectrometry
INEEL	Idaho National Engineering and Environmental Laboratory
MCL	maximum contaminant levels
MDNR	Missouri Department of Natural Resources
NAAQS	National Ambient Air Quality Standard
NPDES	National Pollutant Discharge Elimination System
ppb	parts per billion
ppm	parts per million
QA	quality assurance
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
SIP	State Implementation Plan
START	Superfund Technical Assessment and Response Team
TSP	total suspended particulate
USFWS	U.S. Fish and Wildlife Service
XRF	X-ray fluorescence

Monitoring Plan for Lead Deposition at Herculaneum, Missouri

1. INTRODUCTION

EPA, Region 7, has requested the INEEL prepare a QUAPP for deposition monitoring for the area impacted by the Doe Run Company's lead smelting/refining operation in Herculaneum, Missouri. Elevated blood lead levels have been recorded in 28% of the area's children 6 years and under; 52% for children living within ½ mile of the smelter. These high rates are apparently due to lead fallout from many years of smelter operations, accumulation of lead in soil, and subsequent ingestion. Sources include various stacks and vents from plant processes, fugitive emissions from ore handling operations, wind erosion from slag piles, and fugitive emissions from transport of lead concentrate over local roads. High lead levels in soils and house dust have been recorded. In the recent past, numerous controls under the Missouri State Implementation Plan (SIP) have been imposed on Doe Run's operations. For the first time since air quality has been monitored in Herculaneum, ambient lead levels at all monitoring sites in the first quarter of 2002 were in compliance with the National Ambient Air Quality Standard (NAAQS). It must now be determined whether and at what rate lead deposition may still be occurring in Herculaneum.

1.1 Site Background

The following site description and background is taken from Environmental Protection Agency's (EPA's) "Quality Assurance Project Plan for a site Characterization at the Herculaneum Lead Smelter. Herculaneum, Missouri, CERCLIS ID No. MOD006266373," September 10, 2001, attached as Appendix B of this document.

> *The Herculaneum Lead Smelter (HLS) site is located at 881 Main Street in Herculaneum, Missouri, about 25 miles south of the St. Louis metropolitan area. The site property is approximately 52 acres in size. An approximately 24-acre slag disposal pile is located south of the smelter in a horseshoe bend of Joachim Creek. The slag pile is located in the floodplain of Joachim Creek, in an area classified as a wetland. The smelter site is bordered on the east by the Mississippi River and on the north and west by residential areas. South of the smelter is the slag pile and wetland area. The slag pile is bordered to the east, west, and south by Joachim Creek, and to the north by residential areas and the smelter facility. The slag pile and most of the smelter facility are located in Jefferson County, Section 29, T. 41 N., R.6 E., although the northern portion of the facility extends into Section 20. Geographic coordinates of the site are 38° 15' 19.0" north latitude and 90° 22' 56.7" west longitude.*

> *The site is an active lead smelter, the largest of its kind in the United States. HLS began operations in 1892 as part of the St. Joseph Lead Company. In 1986, it became part of the newly formed Doe Run Company (Doe Run), a joint venture of the Fluor Corporation and the Homestake Mining Company. In 1990, the Fluor Corporation became the sole owner of Doe Run. The site consists of three main areas: (1) the smelter plant, located on the east side of Main Street; (2) the slag storage pile; and (3) office buildings on the west side of Main Street.*

> *The following major processes occur at the HLS site: (1) sintering, smelting, and refining of lead ore; (2) sulfuric acid production from waste sulfur-*

containing gases generated by the sintering operation; and (3) wastewater treatment. The smelting operation generates a molten slag, 20 percent of which is sent to a slag storage pile as waste. The slag pile occupies approximately 24 acres in the floodplain of Joachim Creek, and is up to 40 feet tall in some sections. In 1993, during a major flood event, water reached several feet up the sides of the slag pile. The site also generates stack air emissions from the smelter and fugitive air emissions from various operations (MDNR, 1999).

Several investigations have been conducted at the site, including a Preliminary Assessment/ Screening Site Inspection by the EPA in 1980, a multimedia compliance inspection by the EPA in 1995, a Preliminary Ecological Risk Assessment for Fish and Wildlife Habitats by the U.S. Fish and Wildlife Service (USFWS) in 1998, and a Preliminary Assessment by the Missouri Department of Natural Resources (MDNR) in 1998 and 1999. In addition to these state and federal lead investigations, the facility has collected and submitted to the state a large quantity of environmental data pursuant to Missouri's site-specific State Implementation Plan (SIP) established under the Clean Air Act (CAA), National Pollutant Discharge Elimination System (NPDES) permit, Metallic Minerals Waste Management Act permit, and voluntary soil cleanup efforts in the surrounding Herculaneum community.

Based on previous investigations, primary metal contaminants in the slag pile include arsenic, cadmium, copper, lead, nickel, and zinc. The slag pile has been partially inundated by flood waters in the past. The USFWS identified significant concentrations of lead, cadmium, and zinc in floodplain soils; significant concentrations of lead and zinc in river sediments; and significant zinc concentrations in surface water samples collected from drainage ditches on the Joachim Creek floodplain.

Stack and fugitive emissions from the site, and fall-out from these emissions, have resulted in releases of lead, cadmium, and sulfur dioxide to the air and soil. Since 1980, the smelter's emissions have been regulated under general and site-specific regulation established in the SIP. Lead emissions at one air monitoring station near the site have consistently been above the 1.5 microgram per cubic meter ($\mu g/m^3$) National Ambient Air Quality Standard (NAAQS), since it was installed in 1992. Due to the continued noncompliance with the NAAQS standard, new SIP regulations are being developed by the site and MDNR.

Soil sampling has shown lead levels as high as 150,000 (corrected from QAPP) *parts per million (ppm) in the surface soils of homes surrounding the smelter. A 1992 Jefferson County Health Department study identified 13 homes near the site where children had lead levels greater than 15 micrograms per decaliter (µg/dl). Twelve of these 13 homes had lead levels in the soil ranging from 1,000 to 3,500 ppm, and one had lead levels in the soil up to 999 ppm. Thirteen out of 21 birds tested as part of the USFWS study showed clinical or subclinical lead poisoning based on liver analysis. Fish and tissue samples collected during this study had lead concentrations up to 7.5 ppm. Under a groundwater monitoring program conducted at the site since 1980, lead and cadmium concentrations in the groundwater periodically have been found above the respective maximum contaminant levels (MCLs) established under the Safe*

Drinking Water Act. The MCLs for lead and cadmium are 15 parts per billion (ppb) and 5 ppb, respectively.

In August of 2001, EPA was notified by a Herculaneum citizen of a grey powdery substance on the roads in the town. Further investigation identified the substance containing lead at 300,000 ppm or 30%. Additional field screening identified the trucks delivering lead concentrate to the Doe Run Smelter as the likely source of the material along the haul routes in the town.

1.2 Mitigative Actions To Date

Mitigation actions to date include:

- The top 12 in. of soil has been removed from many residential yards and other properties, and replaced with soil containing less than 250 ppm lead; this activity is ongoing.
- Lead dust on and adjacent to haul roads has been, and continues to be, vacuumed up
- Contaminated roadside soil along haul roads has been removed
- Contaminated dust in houses has been removed
- High efficiency particulate air (HEPA)-filtered vacuum cleaners have been issued to residents by Doe Run and EPA
- The Doe Run Company has implemented or is in the process of implementing controls on most of its operations, and revising other operations to lower emissions.
- The DOE Run Company has been buying properties (some 80 to date) in the most heavily contaminated zone (termed the "buyout zone").

1.3 Pathways from Airborne Lead Particulate to Elevated Blood Lead

Given that most lead enters the bloodstream via the ingestion pathway, possible routes from airborne lead to ingestion are depicted in Figure 1. Only outdoor lead deposition is considered here; it is assumed that most lead transported indoors via foot traffic and dust through open windows originates from nearby contaminated ground surfaces. Direct deposition to soil and indirect deposition to soil via grass, tree leaves, rooftops, and streets and driveways encompass the most significant pathways from airborne lead to soil. The focus of this monitoring plan is on direct deposition from the atmosphere to soil.

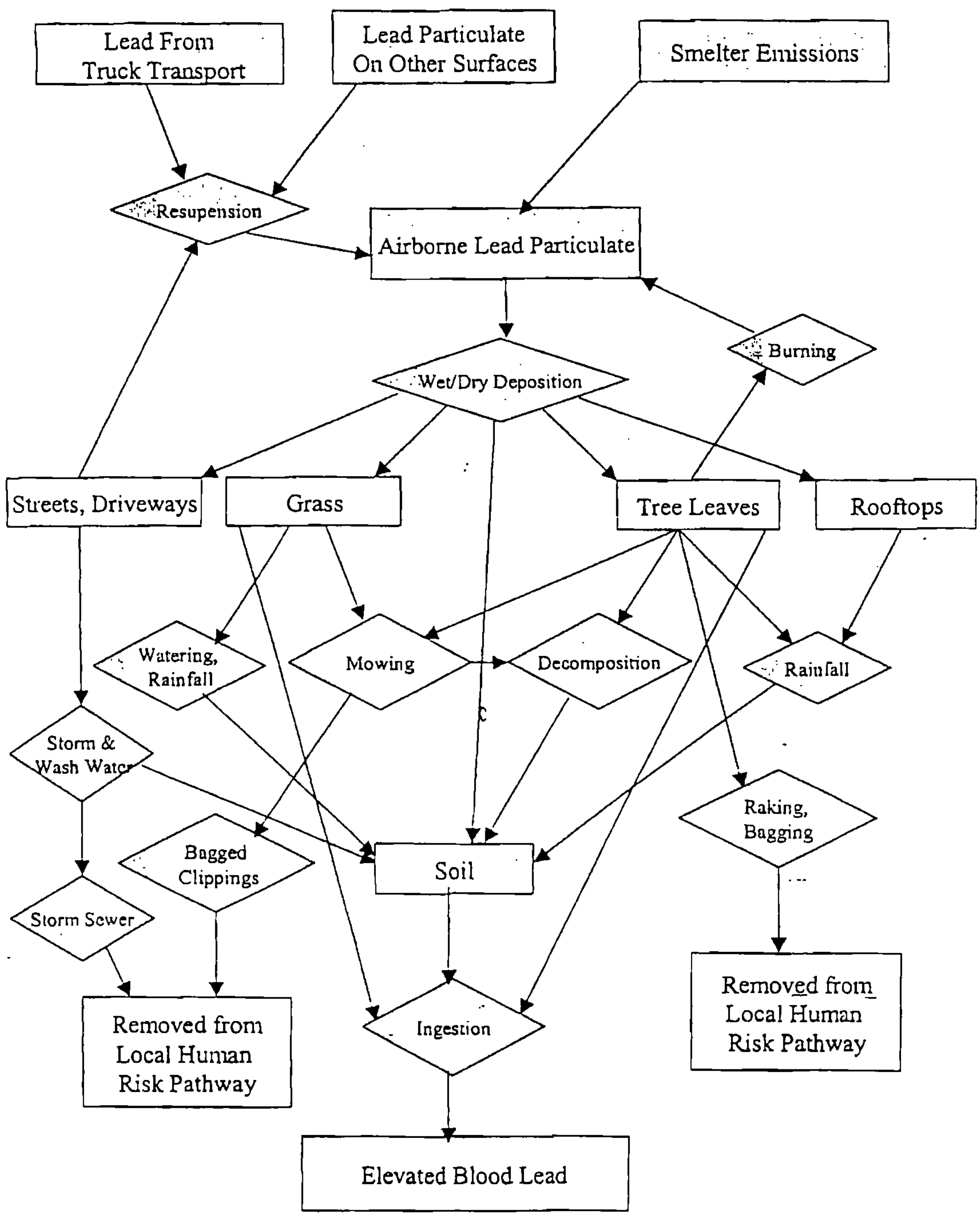


Figure 1. Flowchart depicting physical movement of airborne lead to human blood

2. OBJECTIVES

The objectives of this deposition monitoring effort have been discussed and agreed to among EPA, MDNR, and the Idaho National Engineering and Environmental Laboratory (INEEL), as follows:

1. Determine if properties that have been cleaned under the soil removal program will be recontaminated by lead depositing from air to the extent (400 ppm or greater in top 1 in.) that they must be re-cleaned.

2. Determine the rate of recontamination of soils by atmospheric deposition. That is, how much lead is being deposited per kg of soil (top 1 in.) per unit time (assume we have at least one year to monitor deposition).

3. Develop supportable models of recontamination.

4. Determine if ambient air monitoring data and/or deposition data can be correlated to the rates of recontamination.

5. Determine if estimated rates of recontamination can be correlated to levels predicted by dispersion modeling

6. Determine if specific sources of recontamination can be identified.

2.1 Problem Statement

The problem statement provides a brief description of the problem to be addressed and identifies the project team.

As described in Section 1, surface soils in the town of Herculaneum, Missouri have been heavily contaminated with lead from many years of operation of the Doe Run Company's lead smelter. Sources of lead contamination include stack and fugitive emissions from the many smelter operations, as well as the hauling of lead concentrate over local roads. The goal of this sampling effort is to determine if and at what rate lead deposition is still occurring in and around Herculaneum.

The sampling effort will be lead by the U.S. EPA, Region VII. This QUAPP was developed by the INEEL for EPA through the EPA Technology Support Center (Las Vegas, NV). The field sampling activity will be conducted by EPA's Region VII Superfund Technical Assessment and Response Team (START). Project responsibilities are presented in Table 1. This sampling will be conducted for one full year, subject to continuance based on initial findings (see Section 2.2).

Table 1. Project Responsibilities

Functional Role	Organization	Contact Person
Decision Maker	US EPA, Region VII	Bruce Morrison
		913-551-7755
	-	Morrison.Bruce@~~epamail~~.epa.com
Field Sampling	EPA START Team	Ryan Schuler
		636-475-~~7~~3946
		schulerryan@cs.com
Sample Analysis	Analytical Management Labs	Kendall Lindquist
		913-829-0101, ext. 24

2.2 Decision Identification

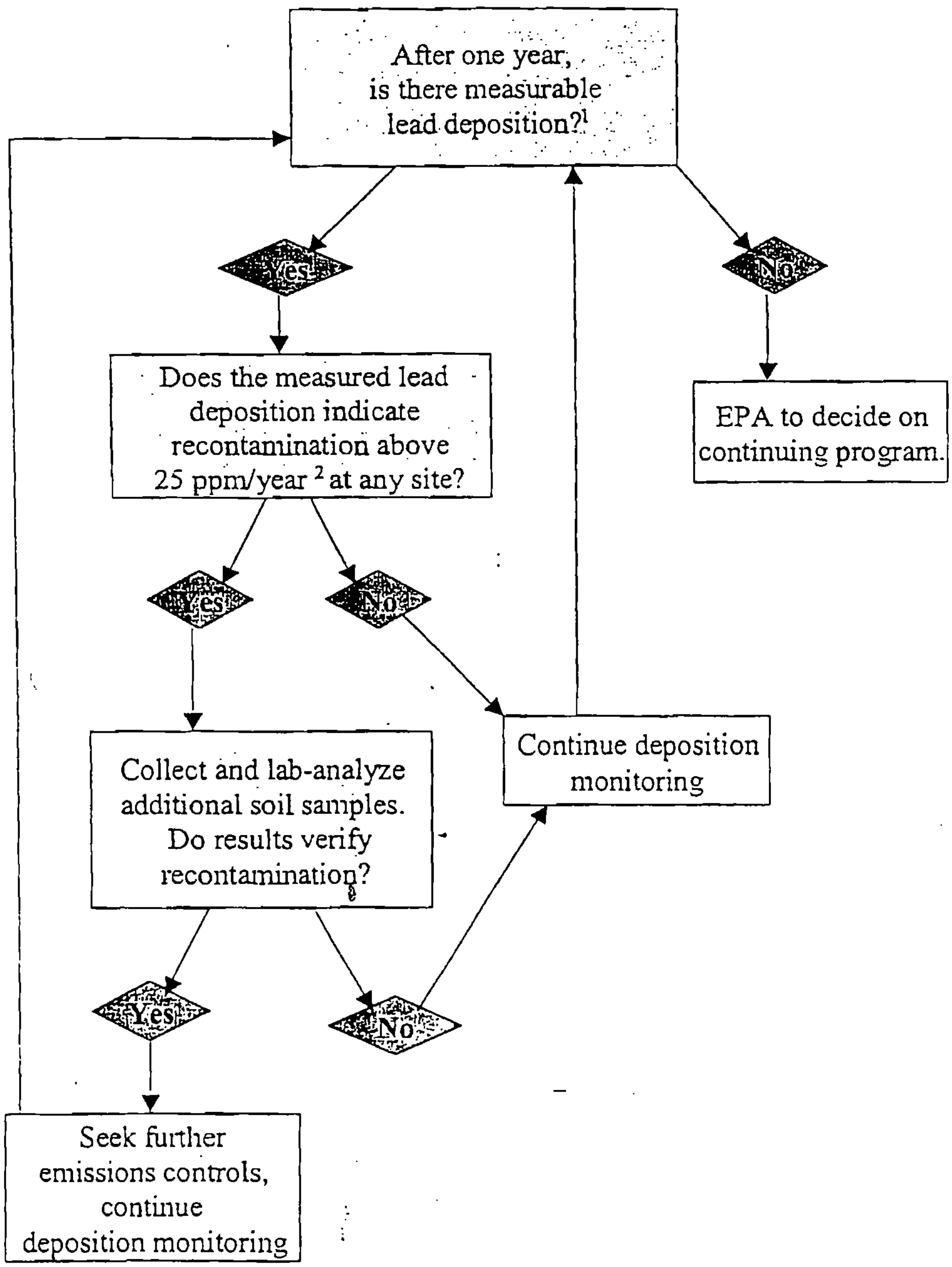
The purpose of this step is to identify the decision to be made based on data collected. The principal question to be addressed by this sampling is: Is lead deposition still occurring in Herculaneum, Missouri at a rate of concern for soil recontamination? The possible actions resulting from resolution of this question are: 1) continue monitoring, refining methods as needed, 2) impose further controls on lead smelter operations and continue monitoring, 3) scale back monitoring to a few sites or methods, or discontinue monitoring. The decision process is depicted in Figure 2.

2.3 Decision Inputs

The purpose of this step is to identify the inputs to the decision discussed in Section 2.2. The decision inputs are: 1) the percentage of deposition samples with measurable lead, 2) rates of increase in soil lead levels as calculated from lead deposition measured on filter paper samplers and as measured in soil boxes and in-situ soil (this program); and 3) rates of increase in soil lead levels measured in composited soil samples (ongoing program). The "acceptable" rate of increase in soil lead concentrations from deposition has not been defined by EPA or MDNR. The action level for soil cleanup is 400 ppm lead in the top 1 in. of soil. Based on deposition rates calculated from air monitoring data, and based on modeled deposition rates, a 25 ppm/year increase in soil lead concentration appears to be a reasonable level on which to base decisions.

2.4 Study Boundaries

This step specifies the spatial and temporal boundaries of the study. The study area consists of the town of Herculaneum, Missouri. Figure 3 shows the spatial extent of EPA's sampling to date. Deposition monitoring will be conducted within this area, except for one sampler being placed as a control south of town (off the map in Figure 3) at the Ursaline high-vol (TSP) sampler site. Deposition monitoring will be conducted for one year, at the end of which, decisions regarding continuance or modification of the program will be made, based on results.



1. > 10% of samples of a given type, at any site statistically > zero or baseline as measured on/in filter papers, soil boxes and in-situ soil
2. In top 1 inch of soil

Figure 2. Possible decision paths based on deposition monitoring results.

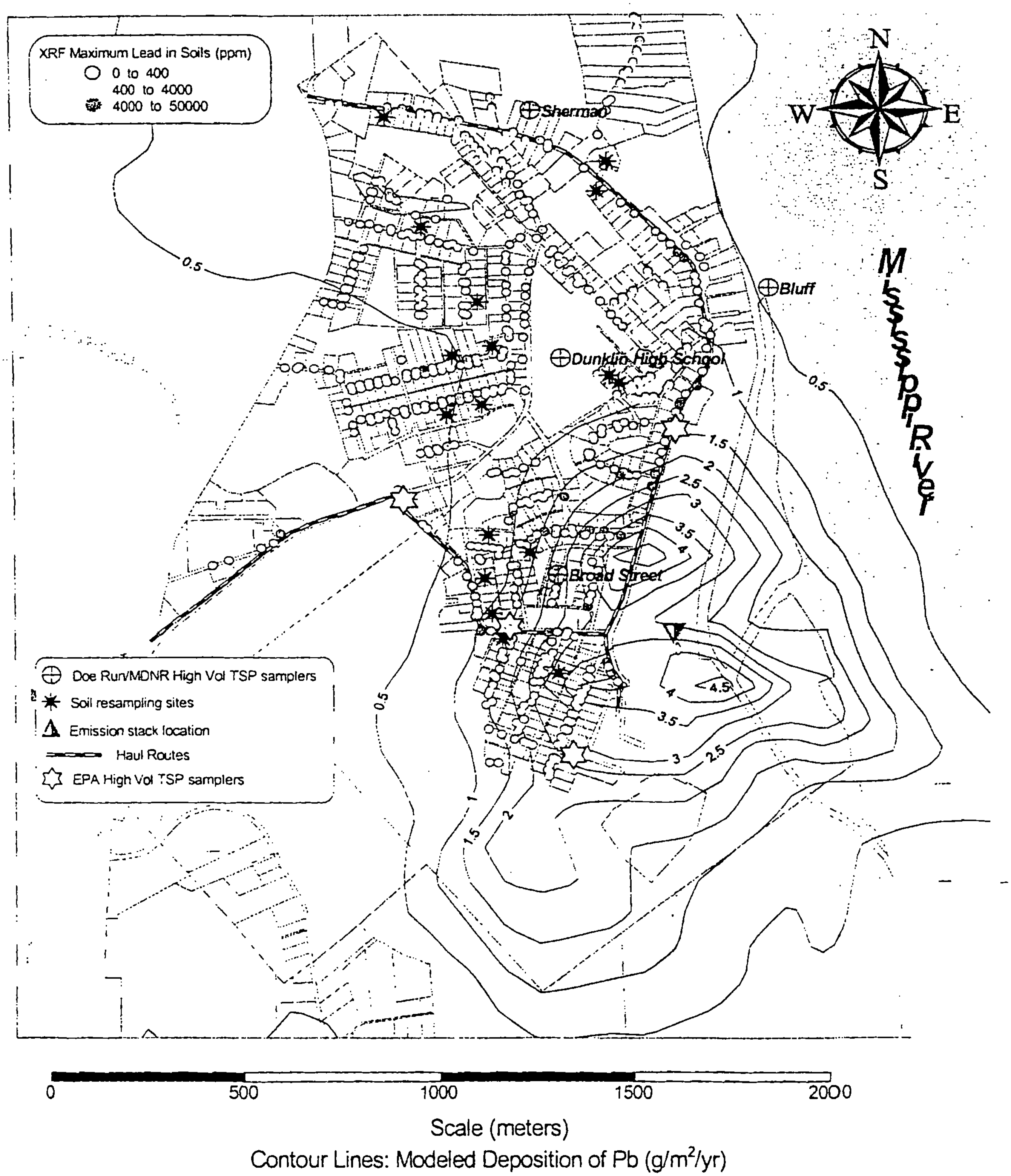


Figure 3. Herculaneum Missouri, showing soil lead levels, air monitor sites, existing soil recontamination study sites, and modeled lead deposition.

2.5 Decision Rule

This step integrates the outputs from the previous steps into a statement that would enable the decision-maker to choose among alternative actions. The decision whether or not lead is being deposited to soil at rates requiring further enforcement actions against Doe Run will be based on combined results of this plan's deposition monitoring and soil sampling already being conducted for EPA's recontamination study. The action level set in this plan is 25 ppm/year lead in the top 1 in. of soil, either calculated from measured deposition, or measured in soil samples. There are two steps to reach the decision (Figure 2): 1) determine if greater than 10% of 1 year's samples of any type at any site are above detection or baseline levels and if so, 2) do any of these samples indicate soil recontamination above the 25 ppm/year action level, then confirmation soil samples will be collected and analyzed in the lab. Positive results indicate further enforcement actions are needed.

2.6 Decision Error Limits

The purpose of this step is to specify the appropriate goals for limiting uncertainty in the decision. Null and alternative hypotheses were developed and are presented, and the probability of making Type 1 and 2 errors is discussed.

The possible range of values for the percentage of deposition monitoring samples showing significant lead deposition range from 0 to 100%.

Null and alternative hypotheses were developed for this monitoring effort. The null hypothesis is that lead is present above detection limits or baseline levels in less than 10% of samples of a given type from a given location; in other words, there is no measurable deposition occurring. The alternative hypothesis is that lead is present above detection limits or baseline levels in greater than 10% of samples, thus indicating that lead deposition is occurring, and further monitoring and evaluation may be required. The objective of this monitoring effort is to test the null hypothesis.

The two types of decision error for this monitoring effort are: 1) deciding that lead deposition is occurring when it is not (Type 1 error), and 2) deciding lead deposition is not occurring when it is (Type 2 error). The consequences of a Type 1 error are additional unnecessary and costly monitoring efforts (see Figure 3). The cost of a Type 2 error is that soil will be recontaminated to the point that it is again a public health threat. There are three decision error limits to specify: the probability of making a Type 1 error, the precision bound, and the probability of making a Type 2 error. The probability of making a Type 1 error is specified as 5% (translated as the 95% confidence interval). The precision requirement is set as the confidence half-width of 0.1 (or 10%). These two factors translate into a requirement that the 95% confidence interval for the null hypothesis is from 0 to 20%. This range is referred to as the "gray area," since the probability of decision errors in this area is large. The probability of making a Type 2 error is dependent on the true percentage of deposition measurements above detection limits or baseline levels. For instance, if 30% of samples indicate lead deposition, the maximum probability of making a Type 2 error is 0.1; if 40% of samples indicate lead deposition, the probability should be 0.001.

2.7 Design Optimization

This step identifies the most effective sampling and analysis strategy that satisfies the data quality objectives.

2.7.1 Sample Design Options

Sample design options are limited for this project because of restrictions on sampling locations. Because samplers will be left out for a month at a time, they must be placed in areas with limited public access to prevent advertent or inadvertent tampering. Therefore, random sampling is virtually impossible. Additionally, one aspect of this study is to assess correlation among deposition measurements, actual soil concentrations, and air sampling data, which necessitates co-location with existing sampling sites. EPA already has a soil sampling program in place (recontamination study), so it is logical to co-locate samplers with soil sampling sites. A Limitation is that not all landowners are likely to allow additional intrusion on their property. EPA and Doe Run/MDNR operate a total of ten high-vol TSP samplers and deposition samplers will be placed at nine of those sites also.

2.7.2 Selected Sample Design

Of necessity, the sample design is non-random, based on existing air and soil sample sites. Sample size was determined from the number of available sample sites.

2.7.2.1 Collection of Duplicate Samples—Because of the nature of the lead contamination in Herculaneum, i.e., much existing ground-level contamination associated with large particles, and smelter emissions likely associated with fine particles, it is anticipated that deposition will be quite variable over time and space. Therefore, at five of the sites (see locations in Section 3.2, below) duplicate filter papers and soil boxes will be staged to provide a measure of precision.

3. SAMPLE DESIGN

This section describes the laboratory and field analyses needed for this monitoring effort, the sampling locations, and data analyses.

3.1 Laboratory/Field Analyses

Analyses performed in the field will consist of field portable X-ray fluorescence (FPXRF) measurements (EPA Method 6200) made directly on in-situ soil and on soil in soil boxes. Deposition filter papers will be analyzed in the laboratory by inductively-coupled plasma/mass spectrometry (ICP/MS), Method 6020.

3.2 Sampling Locations

Deposition monitoring will be set up at 21 locations, as follows:

1. At each of the four existing MDNR/Doe Run-operated high-vol sites shown on Figure 3, plus the Ursaline site south of Herculaneum, considered a control site (not shown on Figure 3),

2. At each of the four EPA-operated high-vol sites (F3, F6, F8, and F10),

3. Adjacent to and 50 m downwind (NNW or SSE) of a haul road. The EPA TSP sampler at the START trailer (F3 - see #2, above) on Station St. will serve as the adjacent site: an additional site 50 m from Station St. NNW or SSE of this location is needed.

4. At eleven of the seventeen residence locations currently being sampled for soil recontamination. According to START personnel, the eleven addresses at which residents are most likely to approve sampler emplacement are:

446 Thurwell - [illegible]	441 Main
438 Washington	439 Hill - No Access
434 Sherman	292 Park
157 Joachim	485 St. Joseph
907 Dale	824 Brown
407 Burris	

At five of the sites [Broad St., Ursaline and Bluff air stations, EPA Air Station F6 (994 Main St.), and either 438 Washington or 485 St. Joseph], duplicate filter papers and soil boxes will be staged. For deposition filters, this may involve mounting additional platforms to the pole (see Section 4.4, below). These sites were selected from the 21 sites based on modeled deposition contours and location with respect to haul roads, to attempt to span what is expected to be a range of deposition rates.

3.3 Data Analysis

Data analysis will consist of first determining what percentage of samples show lead levels significantly above either detection limits (for filters and soil boxes) or above baseline levels (for in-situ soil). After one year, if greater than 10% of samples of any sample type from any location are significantly above detection limits or baseline levels, then further analysis and calculations will be done to determine if the indicated annual deposition would result in greater than 25 ppm additional lead in the top 1 in. of soil. If this is the case, further, confirmatory measurements are indicated (Figure 3).

Data from the various sample types (filters, TSP filters, soil boxes, in-situ soil) will also be compared by correlation analysis to determine if the various measurements are correlated, and if so, if some types of measurements can be dropped from future monitoring.

4. EQUIPMENT AND PROCEDURES

4.1 Artificial Surfaces

Various means have been reported in the literature for measuring deposition using different surfaces. Among the most common are sticky surfaces such as Mylar coated with grease or filter paper coated with oil (Franz et al., 1998; Paode et al., 1998; Yi et al., 2001). Square areas of such samplers are typically small (60 cm^2 or less). We propose using round filter papers, 9 cm diameter or larger (suggest Whatman "Student Grade Circles" filter papers – available in 9 to 15 cm diameters). Filters will be saturated with oil, which serves both to "stick" filters to trays (petri dishes, pie pans, or similar), and to prevent deposited particulate from resuspension.

Filters will be secured on horizontal, flat surfaces (e.g., petri dishes or pie pans) on a pole at 2 levels above ground surface: 0.3 m and 3.0 m. The purpose of sampling at two levels is to attempt to distinguish between larger lead-contaminated particles such as would be resuspended from ground-level sources (and because of their size, remain close to the ground), and those smaller particles that would be expected from smelter operations.

4.2 Soil Boxes

Soil boxes are intended to provide a repeatable means of measuring lead deposition on soil that would be less likely to be disturbed than soil in residential yards. As envisioned by MDNR, soil boxes would be approximately 2 ft × 3 ft, 8-12 in. deep (these could be off-the-shelf plastic storage containers), filled with clean topsoil and set on the ground, or dug in so that soil elevations inside and outside the box are about equal. An option would be to plant the boxes with grass (see Appendix A).

4.3 In-situ Soil

Soil and composite soil samples at recontamination sampling sites will continue to be analyzed by field-portable x-ray fluorescence (FPXRF), per existing protocol, *with samples from air monitoring sites added.* As outlined in the Quality Assurance Project Plan (QAPP) (APPENDIX B), special attention, but separate measurements should be focused on driplines and downspout outflows, since lead from rooftop deposition will be concentrated there.

At each deposition monitoring site, several (5 or more) XRF measurements will be made directly on bare, undisturbed soil. Measurement locations will be established, to the extent practicable, at random directions and distances (but within 5 m) from filter samplers. Markers will be placed and numbered so that the same locations can be measured with the XRF each month. Care must be taken to not disturb these locations.

4.4 Deploying Samplers

At each sampling site a 1.5-2 in. × 12 ft conduit pole would be installed in an augured (post hole size) hole, 18 in. deep, with concrete. Platforms suitable for mounting filter holders would be clamped to the post at the designated heights above ground surface (0.3 and 3.0 m). Small roofs such as vent caps would need to be secured over each platform to keep out rain.[1] Filter holders should be secured to platforms with Velcro strips or other means so that they can be easily removed for filter replacement and cleaning.

Filters would be prepared in a clean environment (lab). Preparation would involve saturating filters with oil (type to be determined by analytical lab) and placing in ziplock bags. Filter holders also would be prepared in the lab by cleaning with an appropriate solvent, then bagging for transport to the field. Filter holders would need to be changed out with filters to prevent contamination of new filters.

Soil boxes would be placed within 5 m of filter samplers, with the soil surface as near ground level as possible, but no higher than the lowest level of filter paper samplers (0.3 m). It will be necessary in most cases to enclose the boxes with chicken wire or hardware cloth to discourage larger animals from disturbing the soil.

At the Dunklin H.S. TSP sampler site, some variation of the above guidance will be necessary. Because Dunklin TSP samplers are on the roof of the building, the sampling site is already elevated. If filter samplers cannot be located nearby and at ground level, only one filter at as near to 3 m above the surrounding ground surface as possible, will be necessary. Also, because this is a school, there may be no location for direct soil measurements or placement of a soil box that can be guaranteed secure or undisturbed.

4.5 Sampling Schedule

EPA (2001) recommends sampling for five years to account for year-to year climate variations. At present, the soil recontamination study is scheduled for one year at least, and this deposition monitoring program is designed to be conducted in concert with the soil program. Sampling data will be evaluated on an ongoing basis and adjustments to methodology, frequency, or sampling locations made as needed.

Deposition filters will be analyzed monthly, on schedule with the residential soil recontamination monitoring program. Depending on lead levels measured and amount of debris on filters (insects, etc.), this schedule may need to be adjusted. Soil boxes and in-situ soil will also be measured monthly, at least initially.

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[1] It is acknowledged that caps over deposition samplers will have some effect on particle collection.

5. SAMPLE HANDLING AND ANALYSIS

Filter papers, both new and "spent" must be handled carefully to avoid cross-contamination and inadvertent contact with possibly contaminated surfaces. Filters will be stored and transported to and from the field in ziplock bags, with each spent filter in a dedicated, labeled bag. One dedicated filter forceps will be used for all clean filters. For spent filters, a clean forceps will be used for each filter then discarded for cleaning; then a clean pair used for the next filter, and so on.

Trays on which filter papers are placed will also be handled to avoid cross-contamination. Trays will be cleaned in the laboratory, placed in ziplock bags, and transported to the field in same. Trays will be changed out with filters, with "dirty" trays bagged and returned to the laboratory for cleaning.

In the laboratory, filters will be halved, with one half analyzed immediately, and the second half stored for composite analysis with other filter halves from each location/sampling height after one year's sample collection.

6. WASTE MANAGEMENT

Laboratory waste will be managed according to applicable regulations and protocol. At the end of the study, soil from soil boxes will be disposed of according to measured lead levels, i.e., if greater than 400 ppm, disposal will be to the soil disposal site south of Herculaneum.

7. QUALITY ASSURANCE

EPA has developed the *Quality Assurance Project Plan for a Site Characterization at the Herculaneum Lead Smelter*, attached as Appendix B. Much of this plan is applicable to quality assurance/quality control (QA/QC) for lead deposition monitoring.

7.1 Quality Objectives and Criteria for Measurement Data

As for the existing soil monitoring program at Herculaneum, the quality assurance (QA) objective for deposition monitoring is to provide valid data of known and documented quality. Data quality objectives (DQO's) are defined on page 5 of the QAPP (Appendix B) in terms of accuracy, precision, completeness, representativeness, and comparability. Means for achieving DQO's for deposition monitoring are summarized in Table 3, below.

In order to specify quality control limits and quality assurance goals for measurement methods, the following suggested approach will be used for the duplicate filter results. The difference between the duplicates for the five sites will be calculated along with the 95% confidence interval for the true mean difference. If the calculated interval is greater than +/- 20% of the mean difference, then it should be considered whether that method is acceptable, or whether it can be improved, or needs to be discontinued.

A somewhat similar approach could be suggested for the blank and spiked sample results. There should be one blank and one spike per sampling interval, or three blanks and three spikes per quarter. The difference between the truth and the measured result will be calculated. The 95% confidence interval for each the blank differences and the spike differences will be calculated. The method might be suspect if the blank confidence interval does not contain zero or if the spike confidence interval does not contain the true value.

Table 3. Means of measuring data quality objectives (DQOs) for deposition monitoring project

DQO	Deposition Samplers (filter papers)	In-situ soil and Soil Boxes
Accuracy	Laboratory-spiked and blank samples; 1 each per sampling interval, or 3 each per quarter	Twice daily calibration checks of field XRF against soil samples with known lead concentrations
Precision	Duplicate samples to be collected at 5 of the 21 stations.	Multiple measurements for each sample site and box; duplicate soil boxes at 5 stations.
Data Completeness	Percentage of valid data	Percentage of valid data
Representativeness	Continuous sampling at 21 sites for one year or longer	Continuous sampling at 21 sites for one year or longer
Data Comparability	Common reporting units (Table 4)	Common reporting units (See Appendix B, p.5).

Table 4. Units for reporting deposition monitoring results.

Measurement	Specific Data Reporting Units
Metals concentrations on filter papers – laboratory	µg/m^2
Metals concentrations on filter papers – field XRF (optional, if feasible)	ppm
Metals in soil box soil and in-situ soil – field XRF	ppm

8. REFERENCES

Franz, T. P., S. J. Eisenreich, and T. M. Holsen (1998). Dry Deposition of Particulate Polychlorinated Biphenyls and Polycyclic Aromatic Hydrocarbons to Lake Michigan, Environ. Sci. Technol. v. 32, no. 23, pp. 3681-3688.

Paode, R. D., S. C. Sofuoglu, J. Sivadechathep, K. E. Noll, T. M. Holsen, and G. J. Keeler (1998). Dry Deposition Fluxes and Mass Size Distributions in Southern Lake Michigan during AEOLOS, Environ. Sci. Technol. v. 32, no. 11, pp. 1629-1635.

Yi, S., U. Shahin, J. Sivadechathep, S. C. Sofuoglu, and T. M. Holsen (2001). Overall elemental dry deposition velocities measured around Lake Michigan. Atmospheric Environment, v. 35, pp. 1133-1140.

Appendix A

Alternative Means of Monitoring Deposition

Alternative Means of Monitoring Deposition

Other deposition and particulate sampling methods and media were considered for this plan, and should be kept in mind for future study.

Low-flow TSP samplers. To provide continuous air monitoring, a network of low-flow, continuous TSP or PM-10 particulate samplers are desirable. The intent of using such samplers is to provide another measure of airborne lead that, if comparable to deposition measurements, may be a simpler system to employ in the future than deposition collectors. Unlike high-vol samplers, which are typically operated one 24-hour period per week, low-vol samplers are less likely to miss a significant meteorological event affecting deposition. If possible, low-volume TSP filters should be analyzed in the field with XRF. Because the filters are small, it may only be possible to take one field XRF measurement, but multiple measurements should be attempted. Filters should then be bagged, labeled and sent to a laboratory for metals analysis. If field XRF and laboratory results are in good agreement, it should be possible to rely on field XRF measurements of TSP filters, with occasional laboratory confirmation..

PM-10 Samplers. The purpose of PM-10 samplers would be to aid characterization of lead particulate size, and hence sources, contributing to recontamination. This is especially important along haul roads, where it is likely that particles are large, and not transported significant distances. TSP and PM-10 samplers placed next to, and at intervals downwind of haul roads would help determine the degree of recontamination due to dust from haul roads.

Grass (lawns). Grass cuttings collected (bagged) by homeowners would be subsampled each cutting cycle: composites of subsamples would be ashed and analyzed for lead and other metals. It may also be feasible to use field XRF on subsamples and/or composite samples. Concentrations per mass of cuttings can then be related back to square areas of grass cut. A complicating factor may be mixing with tree leaves in the fall (see below).

Grass (in soil boxes). An option for soil boxes would be to plant the boxes with grass (alternatively, sections of sod could be used). The grass is intended to lend some realism, and to help hold soil in place so it is not lost to wind events. If planted in grass, a small patch (~10 cm diameter) of bare soil would be left in the center, suitable for measurement with the field XRF unit. Boxes with grass would require some maintenance, i.e., watering and clipping of the grass. The clipped grass would be bagged and composited for laboratory analysis. It may also be feasible to analyze clippings with the field XRF.

Tree Leaves. While tree leaves are likely significant collectors of deposition, it may be difficult to relate lead found on leaves to aerial deposition rates. Leaves may, however, provide a means of comparing deposition among different locations. Interspecies differences in leaf surface characteristics would need to be kept in mind. Leaves could be easily collected in the Fall by raking, at which time they would also likely be incorporated into grass cuttings to varying degrees.

Rooftops/runoff. Rooftops present large areas for deposition, with rain runoff collected from downspouts a potential sample collection point. Variability of roof surfaces and resuspension or adhesion of particulate are complicating factors.

Rainfall. Though it is likely that wet deposition plays a minor role in overall deposition, some attempt should be made to collect and analyze precipitation. To avoid dry deposition into precipitation samplers, they would need to be automatically uncovered/covered during rain/dry periods.

Appendix B

EPA's QAPP

QUALITY ASSURANCE PROJECT PLAN FOR A SITE CHARACTERIZATION AT THE HERCULANEUM LEAD SMELTER HERCULANEUM, MISSOURI CERCLIS ID NO.: MOD006266373

Prepared For:

U.S. Environmental Protection Agency Region VII
Superfund Division
901 North 5th Street
Kansas City, Kansas 66101

Prepared By:

USEPA Region VII Superfund Technical Assessment and Response Team (START) 2

September 10, 2001

APPROVED BY:

START Project Manager, Ryan Schuler	Date
START Program Manager, Hieu Q. Vu, PE, CHMM	Date
(signature) (FOR) EPA Project Manager, Superfund Division, ~~Joe Davis~~	8-9-02 Date
EPA Superfund Quality Assurance Coordinator, Bob Dona	Date

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ATTACHMENTS

1. PROJECT MANAGEMENT

1.1 Distribution List

Region VII EPA	BRUCE A. MORRISON ~~Joe Davis~~, USEPA Project Manager
	Bob Dona, USEPA SuperFund Quality Assurance Coordinator
Region VII START	Ryan Schuler, START Project Manager
	Hieu Q. Vu, START Program Manager
	Ted Faile, START Quality Assurance Manager

1.2 Project/Task Organization/Scope of Work

Ryan Schuler, of the U.S. Environmental Protection Agency (USEPA) Region VII Superfund Technical Assessment and Response Team (START), will serve as the START Project Manager for the activities described in this Quality Assurance Project Plan (QAPP) to be conducted at the Herculaneum Lead Smelter Site in Herculaneum, Missouri. He will be responsible for overall coordination of site activities, ensuring implementation of the QAPP, and providing periodic updates to the client concerning the status of the project, as needed. Joe Davis will be the USEPA Project Manager for this activity.

Eight to ten START members will comprise the field/sampling team. The team will be responsible for assisting EPA with surveying activities, obtaining access to sampling properties, acquisition and calibration of sampling equipment, sample collection, field screening, documentation of residential property conditions and field activities, and coordination of laboratory analyses. The START Quality Assurance (QA) Manager will provide technical assistance, as needed, to ensure that necessary QA issues are adequately addressed.

This QAPP was prepared to address site characterization to determine the extent of soil contamination caused by operations at the Herculaneum Lead Smelter (HLS) site in Herculaneum, Missouri. In addition, air monitoring stations will be established to document fugitive releases of airborne contaminants. The scope of work includes obtaining property access, surveying/marking sampling cells at each property, collection of surface soil samples for field screening and laboratory analyses, and collection of ambient air samples at several locations near the HLS site.

Although an attempt will be made to adhere to this QAPP as much as possible, the proposed activities may be altered in the field if warranted by site-specific conditions and/or unforeseen hindrances that prevent any aspect of this QAPP from being implemented in a feasible manner. Such deviations will be recorded in the site logbook as necessary. This QAPP will be available to the field team(s) at all times during sampling activities to serve as a key reference for the proposed activities described herein.

1.3 Problem Definition/Background/Site Description

This QAPP was prepared by the Tetra Tech START to address imminent and long-term concerns that could impact human health and/or the environment at the HLS site (site), where metals-contaminated soils (predominantly lead, cadmium and zinc) have been identified during previous sampling activities.

The HLS site is located at 881 Main Street in Herculaneum, Missouri, about 25 miles south of the St. Louis metropolitan area (see Attachment A - Figure 1: Site Location Map). The site property is approximately 52 acres in size. An approximately 24-acre slag disposal pile is located south of the smelter in a horseshoe bend of Joachim Creek. The slag pile is located in the floodplain of Joachim Creek, in an area classified as a wetland. The smelter site is bordered on the east by the Mississippi River and on the north and west by residential areas. South of the smelter is the slag pile and wetland area. The slag pile is bordered to the east, west, and south by Joachim Creek, and to the north by residential areas and the smelter facility (see Attachment B - Figure 2: Aerial Photography). The slag pile and most of the smelter facility are located in Jefferson County, Section 29, T. 41 N., R.6 E., although the northern portion of the facility extends into Section 20. Geographic coordinates of the site are 38° 15' 19.0" north latitude and 90 22 56.7" west longitude.

The site is an active lead smelter, the largest of its kind in the United States. HLS began operations in 1892 as part of the St. Joseph Lead Company. In 1986, it became part of the newly formed Doe Run Company (Doe Run), a joint venture of the Fluor Corporation and the Homestake Mining Company. In 1990, the Fluor Corporation became the sole owner of Doe Run. The site consists of three main areas: (1) the smelter plant, located on the east side of Main Street; (2) the slag storage pile; and (3) office buildings on the west side of Main Street.

The following major processes occur at the HLS site: (1) sintering, smelting, and refining of lead ore; (2) sulfuric acid production from waste sulfur-containing gases generated by the sintering operation; and (3) wastewater treatment. The smelting operation generates a molten slag, 20 percent of which is sent to a slag storage pile as waste. The slag pile occupies approximately 24 acres in the floodplain of Joachim Creek, and is up to 40 feet tall in some sections. In 1993, during a major flood event, water reached several feet up the sides of the slag pile. The site also generates stack air emissions from the smelter and fugitive air emissions from various operations (MDNR, 1999).

Several investigations have been conducted at the site, including a Preliminary Assessment/ Screening Site Inspection by the EPA in 1980, a multimedia compliance inspection by the EPA in 1995, a Preliminary Ecological Risk Assessment for Fish and Wildlife Habitats by the U.S. Fish and Wildlife Service (USFWS) in 1998, and a Preliminary Assessment by the Missouri Department of Natural Resources (MDNR) in 1998 and 1999. In addition to these state and federal lead investigations, the facility has collected and submitted to the state a large quantity of environmental data pursuant to Missouri's site-specific State Implementation Plan (SIP) established under the Clean Air Act (CAA), National Pollutant Discharge Elimination System (NPDES) permit, Metallic Minerals Waste Management Act permit, and voluntary soil cleanup efforts in the surrounding Herculaneum community.

Based on previous investigations, primary metal contaminants in the slag pile include arsenic, cadmium, copper, lead, nickel, and zinc. The slag pile has been partially inundated by flood waters in the past. The USFWS identified significant concentrations of lead, cadmium, and zinc in floodplain soils; significant concentrations of lead and zinc in river sediments; and significant zinc concentrations in surface water samples collected from drainage ditches on the Joachim Creek floodplain.

Stack and fugitive emissions from the site, and fall-out from these emissions, have resulted in releases of lead, cadmium, and sulfur dioxide to the air and soil. Since 1980, the smelter's emissions have been regulated under general and site-specific regulation established in the SIP. Lead emissions at one air monitoring station near the site have consistently been above the 1.5 microgram per cubic meter ($\mu g/m^3$) National Ambient Air Quality Standard (NAAQS), since it was installed in 1992. Due to the continued noncompliance with the NAAQS standard, new SIP regulations are being developed by the site and MDNR.

Soil sampling has shown lead levels as high as 12,800 parts per million (ppm) in the surface soils of homes surrounding the smelter. A 1992 Jefferson County Health Department study identified 13 homes near the site where children had lead levels greater than 15 micrograms per decaliter (μg/dl). Twelve of these 13 homes had lead levels in the soil ranging from 1,000 to 3,500 ppm, and one had lead levels in the soil up to 999 ppm. Thirteen out of 21 birds tested as part of the USFWS study showed clinical or subclinical lead poisoning based on liver analysis. Fish and tissue samples collected during this study had lead concentrations up to 7.5 ppm. Under a groundwater monitoring program conducted at the site since 1980, lead and cadmium concentrations in the groundwater periodically have been found above the respective maximum contaminant levels (MCLs) established under the Safe Drinking Water Act. The MCLs for lead and cadmium are 15 parts per billion (ppb) and 5 ppb, respectively.

In August of 2001, EPA was notified by a Herculaneum citizen of a grey powdery substance on the roads in the town. Further investigation identified the substance containing lead at 300,000 ppm or 30%. Additional field screening identified the trucks delivering lead concentrate to the Doe Run Smelter as the likely source of the material along the haul routes in the town.

1.4 Project/Task Description

The activities described in this QAPP will address the following:

A. The extent of soil contamination in residential yards, day-care facilities, areas in schoolyards frequented by children, parks, and all other child high-use areas affected by the HLS operations located east of and adjacent to U. S. Highway 61 and north of Joachim Creek in the township of Herculaneum. In addition, all residential yards and child high-use areas adjacent to or north of Old Route 61 Highway between the Joachim Creek overpass and U.S. Highway 61 shall be characterized. This includes all residential lots owned by the Doe Run Company and vacant residential lots.

B. If the results of the site characterization along haul routes conducted in item A above indicate that high levels of surface soil contamination exists beyond the boundaries specified, sampling will be conducted to delineate the extent of this contamination in residential yards, day-care facilities, areas in schoolyards frequented by children, parks, and all other high use areas affected by the HLS operations.

1.5 Quality Objectives and Criteria for Measurement Data

The QA objective for this project is to provide valid data of known and documented quality. Specific Data Quality Objectives (DQO's) are discussed in terms of accuracy, precision, completeness, representativeness, and comparability.

For this project, accuracy is defined as the ratio, expressed as a percentage, of a measured value to a true or reference value. The measurement process of a contaminant concentration includes separate field and laboratory measurements. Errors are associated with each of these two types of measurements. These errors will be quantified and expressed as a measure of accuracy. The analytical component of accuracy will be expressed as Percent Recovery based on the analysis of lab-prepared spike samples and Performance Evaluation (PE) audit samples.

Precision for this project is defined as a measure of agreement among individual measurements of the same property and will be expressed via duplicate samples. The overall precision is assessed by collection of duplicate or collocated samples. Approximately 10% of duplicate/collocated samples is anticipated.

Data completeness will be expressed as the percentage of data generated that is considered valid. A completeness goal of 100% will be applied to this project; however, if that goal is not met, site decisions may still be made based on the remaining data. No specific critical samples have been identified for the project.

Representativeness of collected samples is facilitated by establishing and following criteria and procedures identified in this QAPP.

Data comparability is achieved by requiring all data generated for the project be reported in common units. The following table lists the various types of data that will be generated and the specific reporting units.

Specific Data Reporting Units

PARAMETER	UNIT
Metals in Soil by X-ray Fluorescence Spectrometer (XRF)	ppm
Metals in Soil by Laboratory Analysis	milligrams per kilogram (mg/kg)
Metals in Air	micrograms per cubic meter ($\mu g/m^3$)
Sampled Air Volume at Standard Temperature and Pressure (STP)	cubic meters at STP (m^3 STP)
Sampling Flowrate at STP	cubic meters per minute at STP (m^3/min STP)
Wind Speed	miles per hour (mph)
Wind Direction (Field Report)	degrees on an azimuth compass
Temperature	degrees Farenheit (°F)
Barometric Pressure (not corrected to sea level)	millimeters of mercury (mm Hg)
Time	military time (00:00 - 24:00)
Date	month/day/year

1.6 Special Training Requirements/Certification

All site personnel will be required to have completed a basic 40-hour health and safety (Hazardous Waste Operations and Emergency Response [HAZWOPER]) training course and annual refreshers. Familiarization with the Niton™ XRF and its operating procedures will also be necessary for the START members.

1.7 Documentation and Records

START personnel will maintain a field logbook to record all pertinent activities associated with the sampling events. Appropriate documentation pertaining to photographs taken by START will also be recorded in the field logbook. Information pertaining to all samples (i.e., sampling dates/times, locations, etc.) collected during this event will be recorded on sample field sheets generated by START. Labels generated by START will be affixed to sample containers, identifying sample numbers, dates collected, and requested analyses. Chain of custody records will be completed/maintained for all samples from the time of their collection until they are submitted to the laboratory for analysis.

A health and safety plan will be prepared by START prior to the field activities that will address site-specific hazards. The health and safety plan will be reviewed and signed by all field personnel prior to field work, indicating that they understand the plan and its requirements. Copies of the plan will be available to all personnel throughout the sampling activities.

2. MEASUREMENT/DATA ACQUISITION

2.1 Sampling Process Design

The proposed sampling scheme for this project will be in accordance with the Removal Program Representative Sampling Guidance, Volume 1: Soil, OSWER Directive 9360.4-10, November 1991, and judgmental (based on the best professional judgement of the sampling team). The sampling design proposed in the following paragraphs has been selected to identify the extent of soil contamination at the site. The proposed number of samples is a balance between cost and coverage and represents a reasonable attempt to meet the study objectives while staying within the budget constraints of a typical site investigation.

The characterization sampling will be conducted in a priority hierarchy as follows:

A. Residential yards where a known child under 7 years old resides.

B. Residential yards along the primary and secondary concentrate haul routes.

C. Child high use areas.

At a minimum, residential properties located in the previously identified area will have four quadrants established around the home, which will radiate out 50 feet from each side of the home. In each quadrant, a nine-aliquot composite sample will be collected from the upper 1 inch of soil and screened with a Niton™ XRF. Therefore, a minimum of 4 four samples will be collected from each resedential property. Soil samples will not be collected from within 3 feet of the residential dwellings to reduce the potential lead-based paint contribution to soil-lead concentrations. In addition, multi-aliquot surface soil samples will be taken at the drip line of each structure where a child under 6 years old with elevated blood lead is known to reside. Multi-aliquot surface soil samples will also be collected from any play areas, gardens, sand piles, unpaved driveways, and other areas appearing to be frequented by children. The number of aliquots for these areas will be dependent upon size, but, in general, will follow the aliquot density used for the quadrants.

A 9-aliquot soil sample will be collected from the five-foot section of residential yards and high child use areas adjacent to roads used as haul routes by the Doe Run Company and within the first 50 yards of the streets intersecting with those haul routes.

In addition to soil sampling at residential properties, indoor dust samples will be collected at residential homes which meet the one of the following criteria: 1) homes which have a child less than 6 years of age; and 2) homes which have an XRF screening concentration of greater than 10,000 ppm from any area of the yard.

For locations where there are no residences, a center point, depicting a possible future building site, will be established and flagged. From the center point, four quadrants will be established, which will radiate out 100 feet in each compass direction, and the aforementioned sampling protocols will be completed (e.g. collecting a nine-aliquot composite from each quadrant).

If the results of the screening characterization conducted indicate that surface soil contamination exists (i.e., lead concentrations greater than 400 ppm) beyond the specified limits, further sampling will be conducted on properties beyond the defined sampling.

In addition to soil sampling, four to five ambient air sampling apparatus will be established at several locations near the smelter to determine the potential impact of transporting lead materials from and to the smelter. Specific monitoring locations will be based on field judgment. The monitoring locations will include high traffic and low traffic areas, in order to study any differences. The sampling apparatus will include Hi-Vol and PM-10 Hi-Vol air monitoring instruments. The air monitoring instruments will be placed on the ground. At least one Hi-Vol and one PM-10 Hi-Vol will be collocated at one location.

A summary of anticipated samples to be collected for this project is provided in the following table. The exact number will depend on field screening results, as previously described. Approximately 10 percent of all screening samples will be collected for laboratory confirmation analysis.

	Number of Samples		
Matrix	Field Screening (Lead)	Laboratory	Laboratory Analyses[a]
Soil	4,000	400	Lead, cadmium, arsenic, zinc, nickel
Dust	NA[b]	250	Lead, cadmium, arsenic, zinc, nickel
Air	NA	200	Lead, cadmium, arsenic, zinc, nickel

a. See Section 2.4 for details pertaining to analyses.

b. NA = Not Applicable

2.2 Sampling Methods Requirements

Soil samples will be collected following the EPA Region 7 SOP #2231.12A: ERT #2012; "Soil Sampling". Confirmation soil samples will be collected with a clean, dedicated stainless steel spoon and homogenized in a clean, dedicated aluminum pie pan. The samples will be screened with the XRF after homogenizing the soil, and three consecutive XRF readings will be collected. The three homogenized XRF readings will be recorded on a field sheet. Screening samples using the XRF will follow EPA Region 7 SOP # 4231.707A. The location of the XRF readings (as well as confirmation sample location, if necessary) will also be recorded on each field sheet. Confirmation samples will be transferred directly into the appropriate container for analysis. The samples will be submitted to a subcontracted laboratory.

Indoor dust sampling will be conducted in accordance with EPA Region 7 SOP #4231.1 1A with a minor modification to include the use of a hand-held electric vacuum sweeper. A dedicated filter will be used for each sample. The dust sample will be collected from an adequate area to provide a minimum of 5 grams of weight. The sampling area will include high traffic areas, children bedrooms, and/or undisturbed areas. Pertinent sampling information will be documented on field sheets. The dust sample will be transferred directly into a dedicated ziplock bag and labeled for laboratory analysis.

All ambient air sampling will be accomplished using Hi-Vol and PM-10 Hi-Vol Air Samplers (manufactured by General Metals Work, Inc., Village of Cleves, Ohio), or equivalent The samplers will be operated in accordance with EPA Region 7 SOP No. 2314.1A and No. 2314.2A except where procedures differ from this QAPP. In all cases, the policies described in this QAPP shall take precedence over other EPA SOPs. Each sampler will be positioned on the ground level. Suitable supporting structures meeting all local and Federal safety codes will be used. Samplers will be operated continuously for a 24-hour (±10%) sampling duration. Sampler start and completion times will be referenced to 2400 hours.

Air samples may be voided by the EPA OSC or START Project Manager under the following conditions: (1) If the sampling duration is outside the 21.6 to 26.4 hour limit; (2) evidence of sample tampering is observed; or (3) sample is known to be unrepresentative (due to contamination, sampler failure, etc.).

One meteorological station will be established for the air monitoring. The station will be sited and operated in accordance with "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV Meteorological Measurements", EPA-600/4-82-060, August 1989. Specifically, the station will measure wind direction, wind speed, and temperature from a height of 10 meters. Data logging will be accomplished electronically using an averaging time of 1 hour. Surface pressure (not corrected to sea level) will be recorded hourly. If larger scale meteorological data are required, such "synoptic" data will be acquired from the nearest US Geological Survey stream recording station or from the nearest reporting airport.

Disposal of investigation-derived wastes (IDW) and procedures for equipment/personal decontamination will be addressed in a site-specific health and safety plan prepared by the Tetra Tech START. In general, it is anticipated that most IDW will consist of disposable sampling supplies (gloves, paper towels, etc.) that will be disposed of off-site as uncontaminated debris.

2.3 Sample Handling and Custody Requirements

Samples will be collected in accordance with procedures defined in Region VII EPA SOP 2130.4B. Chain of custody procedures will be maintained as directed by Region VII EPA SOP 2130.2A. Samples will be accepted by the contracted laboratory according to their specific procedures and SOPs.

All soil sample containers will be placed in plastic bags to control spillage in case the containers break during shipment. Soil and dust samples will be placed in coolers containing packing material and enough ice to ensure that the temperature of the samples does not exceed 4°C. Necessary paperwork for all samples, including chain of custody records, will be completed by the Tetra Tech START and maintained with the coolers until delivery to the laboratory. If shipment of the samples is required via commercial service, each cooler lid will be securely taped shut, and two custody seals will be signed/dated and placed across the lid opening. The samples will be submitted to the receiving laboratory by START personnel in a time-efficient manner to ensure that the applicable holding times are not exceeded.

2.4 Analytical Methods Requirements

The samples will be analyzed at a pre-qualified laboratory contracted by the Tetra Tech START, according to the EPA methods listed in the following table. Detection limits that are typically reported by those methods are expected to be adequate for this activity. The requested analyses have been selected based on past sampling data and historical information collected for the site:

ANALYTICAL METHODS	
Analytical Parameter[a]	EPA Method Number
SOIL/DUST	
Lead, cadmium, arsenic, zinc, nickel	SW846 Method 6010B
AIR	
Lead, cadmium, arsenic, zinc, nickel	SW846 Method 6010 B and 7000 Series

a. EPA may cease the analysis for zinc and nickel content if zinc and nickel concentrations in the initial confirmation samples are consistently below MDNR's Any Use Soil Levels.

2.5 Quality Control Requirements

Because dedicated supplies will be used for all samples (i.e., stainless steel spoons, pie pans, etc.), no QC samples will be required to assess the potential for cross-contamination. Analytical error (precision and accuracy) will be determined by the analysis of laboratory-prepared duplicates and spike samples. These criteria, along with other laboratory QC elements, will be performed in accordance with the contract laboratory's quality assurance plan.

To satisfy the quality control elements for the XRF, data will be collected and analyzed for comparability to laboratory data, to determine detection and quantitation limits, and to determine accuracy and precision. The mean of the three XRF readings taken for each confirmation sample will be compared statistically to the laboratory results for each confirmation sample to assess comparability. The measure of agreement (r^2) for the XRF unit should be above 0.7 or greater for the XRF data to be considered screening level data.

For every measurement, the Niton™ gives an uncertainty range that represents a 95 percent confidence interval. In general, precision/accuracy increases with increasing sample run time. Due to preliminary sample results indicating high lead levels, XRF sample run time will be increased accordingly to improve precision and accuracy. The goal is for samples to be screened long enough to obtain precision measurements within 20% of the actual concentrations.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Testing, inspection, and maintenance of all sampling equipment and supplies, along with field screening instrumentation, will be performed by START personnel prior to deployment for field activities. Testing, inspection, and maintenance of analytical instrumentation will be performed in accordance with the contracted laboratory's analytical SOPs and manufacturers' recommendations.

2.7 Instrument Calibration and Frequency

Calibration of the field screening and laboratory analytical instrumentation will be in accordance with the referenced SOPs and manufacturers' recommendations.

2.8 Inspection/Acceptance Requirements for Supplies and Consumables

All sample containers will meet EPA criteria for cleaning procedures required for low-level chemical analysis. Sample containers will have Level II certifications provided by the manufacturer in accordance with pre-cleaning criteria established by EPA in *Specifications and Guidelines for Obtaining Contaminant-Free Sample Containers*. The certificates of cleanliness will be maintained in the project file.

2.9 Data Acquisition Requirements

Previous data/information pertaining to the site (including other analytical data, reports, photos, maps, etc., which are referenced in this QAPP) have been compiled by START from various sources. Some of that data has not been verified; however, that information will not be used for decision-making purposes without verification of its authenticity.

2.10 Data Management

All laboratory data will be managed as specified in the contract laboratory's QAM. Preliminary data will be received by the project manager on site. The final data package will be forwarded to a chemist trained in data validation to complete the validation process. The results will be summarized and included in the report submitted to EPA.

3. ASSESSMENT/OVERSIGHT

3.1 Assessments and Response Actions

Assessment and response actions pertaining to analytical phases of the project are addressed in the contracted laboratory's quality assurance manual(s). Because of the short duration of this sampling event, no field audits of sampling procedures will be performed. Corrective actions will be taken at the discretion of the EPA Project Manager, whenever there appears to be problems that could adversely affect data quality and/or resulting decisions affecting future response actions pertaining to the site.

3.2 Reports to Management

A letter report describing the sampling techniques, locations, problems encountered (with resolutions to those problems), and interpretation of analytical results will be prepared by START, following completion of the field activities described herein and validation of laboratory data. The laboratory data for soil samples will be compared to all applicable or relevant and appropriate requirements (ARARs), including removal action levels that have been established for the site, to determine whether further response is warranted.

4. DATA VALIDATION AND USABILITY

4.1 Data Review, Validation, and Verification Requirements

Data review and verification will be performed by a qualified laboratory analyst and the laboratory's section manager in accordance with the contracted lab's quality assurance program. Follow-up validation of the data will be performed by a Tetra Tech START chemist. The START Project Manager will be responsible for overall validation and final approval of the data, in accordance with the projected use of the results.

4.2 Validation and Verification Methods

A qualified Tetra Tech START chemist will review the data for laboratory spikes/duplicates and laboratory blanks to ensure that they are acceptable. The START Project Manager will inspect the data to provide a final review. The START Project Manager will also compare the sample descriptions with the field sheets for consistency and will ensure that any anomalies in the data are appropriately documented.

4.3 Reconciliation With User Requirements

If data quality indicators do not meet the project's requirements as outlined in this QAPP, the data may be discarded, and re-sampling and/or re-analysis may be required.

ATTACHMENT A

Figure 1: Site Location Map

(One page)

Not to Scale

Herculaneum Lead Smelter
Herculaneum, Missouri

Figure 1
Site Location Map

Tetra Tech EM Inc.

rce: USGS Festus MO 7.5 Minute Topo Quad

ATTACHMENT B

Figure 2: Aerial Photography

(One page)

Not to Scale

Herculaneum Lead Smelter
Herculaneum, Missouri

Figure 2
Aerial Photography

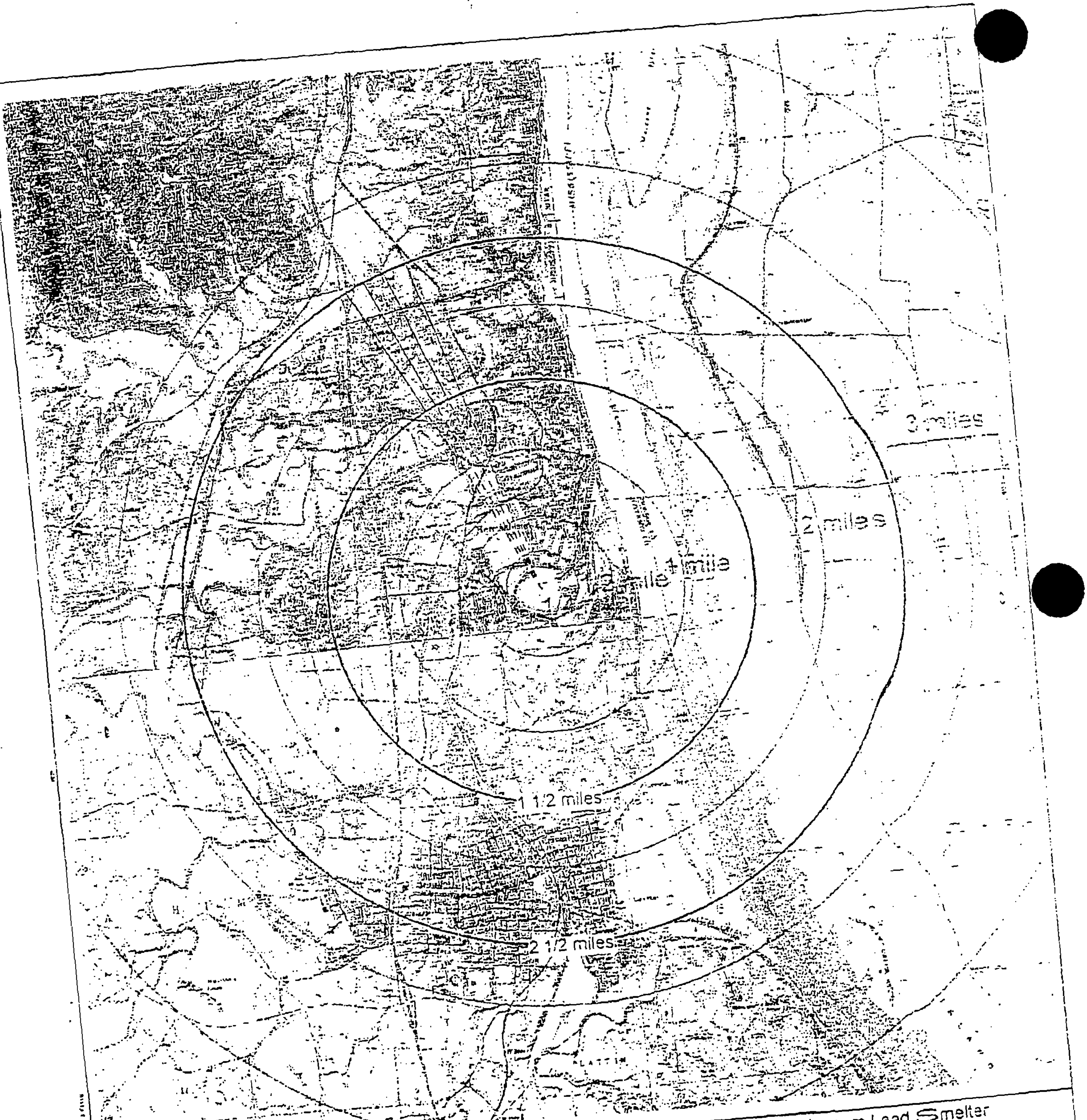
Tetra Tech EM Inc.

rce: USGS Aerial Photo & CARES Internet Map Server,
University of Missouri-Columbia

ATTACHMENT C

Figure 3: Sampling Map

(One page)



Herculaneum Lead Smelter
Herculaneum, Missouri

Figure 3
Sampling Map

Tetra Tech EM Inc.

Legend
- Radius rings
- Transect lines
- Transect lines where sampling will occur

Not to Scale

Note: Samples will be taken every 200 hundred feet along the transect lines between the 1 1/2 miles radius ring and the 2 1/2 miles radius ring.

Source: USGS Festus MO 7.5 Minute Topo Quad

Appendix B

EPA's QAPP

QUALITY ASSURANCE PROJECT PLAN FOR A SITE CHARACTERIZATION AT THE HERCULANEUM LEAD SMELTER HERCULANEUM, MISSOURI CERCLIS ID NO.: MOD006266373

Prepared For:

U.S. Environmental Protection Agency Region VII
Superfund Division
901 North 5th Street
Kansas City, Kansas 66101

Prepared By:

USEPA Region VII Superfund Technical Assessment and Response Team (START) 2

September 10, 2001

APPROVED BY:

START Project Manager, Ryan Schuler	Date
START Program Manager, Hieu Q. Vu, PE, CHMM	Date
EPA Project Manager, Superfund Division, ~~Joe Davis~~	8-9-02 Date
EPA Superfund Quality Assurance Coordinator, Bob Dona	Date

TABLE OF CONTENTS

ATTACHMENTS

1. PROJECT MANAGEMENT

1.1 Distribution List

Region VII EPA	Bruce A. Morrison ~~Joe Davis~~, USEPA Project Manager
	Bob Dona, USEPA SuperFund Quality Assurance Coordinator
Region VII START	Ryan Schuler, START Project Manager
	Hieu Q. Vu, START Program Manager
	Ted Faile, START Quality Assurance Manager

1.2 Project/Task Organization/Scope of Work

Ryan Schuler, of the U.S. Environmental Protection Agency (USEPA) Region VII Superfund Technical Assessment and Response Team (START), will serve as the START Project Manager for the activities described in this Quality Assurance Project Plan (QAPP) to be conducted at the Herculaneum Lead Smelter Site in Herculaneum, Missouri. He will be responsible for overall coordination of site activities, ensuring implementation of the QAPP, and providing periodic updates to the client concerning the status of the project, as needed. Joe Davis will be the USEPA Project Manager for this activity.

Eight to ten START members will comprise the field/sampling team. The team will be responsible for assisting EPA with surveying activities, obtaining access to sampling properties, acquisition and calibration of sampling equipment, sample collection, field screening, documentation of residential property conditions and field activities, and coordination of laboratory analyses. The START Quality Assurance (QA) Manager will provide technical assistance, as needed, to ensure that necessary QA issues are adequately addressed.

This QAPP was prepared to address site characterization to determine the extent of soil contamination caused by operations at the Herculaneum Lead Smelter (HLS) site in Herculaneum, Missouri. In addition, air monitoring stations will be established to document fugitive releases of airborne contaminants. The scope of work includes obtaining property access, surveying/marking sampling cells at each property, collection of surface soil samples for field screening and laboratory analyses, and collection of ambient air samples at several locations near the HLS site.

Although an attempt will be made to adhere to this QAPP as much as possible, the proposed activities may be altered in the field if warranted by site-specific conditions and/or unforeseen hindrances that prevent any aspect of this QAPP from being implemented in a feasible manner. Such deviations will be recorded in the site logbook as necessary. This QAPP will be available to the field team(s) at all times during sampling activities to serve as a key reference for the proposed activities described herein.

1.3 Problem Definition/Background/Site Description

This QAPP was prepared by the Tetra Tech START to address imminent and long-term concerns that could impact human health and/or the environment at the HLS site (site), where metals-contaminated soils (predominantly lead, cadmium and zinc) have been identified during previous sampling activities.

The HLS site is located at 881 Main Street in Herculaneum, Missouri, about 25 miles south of the St. Louis metropolitan area (see Attachment A - Figure 1: Site Location Map). The site property is approximately 52 acres in size. An approximately 24-acre slag disposal pile is located south of the smelter in a horseshoe bend of Joachim Creek. The slag pile is located in the floodplain of Joachim Creek, in an area classified as a wetland. The smelter site is bordered on the east by the Mississippi River and on the north and west by residential areas. South of the smelter is the slag pile and wetland area. The slag pile is bordered to the east, west, and south by Joachim Creek, and to the north by residential areas and the smelter facility (see Attachment B - Figure 2: Aerial Photography). The slag pile and most of the smelter facility are located in Jefferson County, Section 29, T. 41 N., R.6 E., although the northern portion of the facility extends into Section 20. Geographic coordinates of the site are 38° 15' 19.0" north latitude and 90 22 56.7" west longitude.

The site is an active lead smelter, the largest of its kind in the United States. HLS began operations in 1892 as part of the St. Joseph Lead Company. In 1986, it became part of the newly formed Doe Run Company (Doe Run), a joint venture of the Fluor Corporation and the Homestake Mining Company. In 1990, the Fluor Corporation became the sole owner of Doe Run. The site consists of three main areas: (1) the smelter plant, located on the east side of Main Street; (2) the slag storage pile; and (3) office buildings on the west side of Main Street.

The following major processes occur at the HLS site: (1) sintering, smelting, and refining of lead ore; (2) sulfuric acid production from waste sulfur-containing gases generated by the sintering operation; and (3) wastewater treatment. The smelting operation generates a molten slag, 20 percent of which is sent to a slag storage pile as waste. The slag pile occupies approximately 24 acres in the floodplain of Joachim Creek, and is up to 40 feet tall in some sections. In 1993, during a major flood event, water reached several feet up the sides of the slag pile. The site also generates stack air emissions from the smelter and fugitive air emissions from various operations (MDNR, 1999).

Several investigations have been conducted at the site, including a Preliminary Assessment/ Screening Site Inspection by the EPA in 1980, a multimedia compliance inspection by the EPA in 1995, a Preliminary Ecological Risk Assessment for Fish and Wildlife Habitats by the U.S. Fish and Wildlife Service (USFWS) in 1998, and a Preliminary Assessment by the Missouri Department of Natural Resources (MDNR) in 1998 and 1999. In addition to these state and federal lead investigations, the facility has collected and submitted to the state a large quantity of environmental data pursuant to Missouri's site-specific State Implementation Plan (SIP) established under the Clean Air Act (CAA), National Pollutant Discharge Elimination System (NPDES) permit, Metallic Minerals Waste Management Act permit, and voluntary soil cleanup efforts in the surrounding Herculaneum community.

Based on previous investigations, primary metal contaminants in the slag pile include arsenic, cadmium, copper, lead, nickel, and zinc. The slag pile has been partially inundated by flood waters in the past. The USFWS identified significant concentrations of lead, cadmium, and zinc in floodplain soils; significant concentrations of lead and zinc in river sediments; and significant zinc concentrations in surface water samples collected from drainage ditches on the Joachim Creek floodplain.

Stack and fugitive emissions from the site, and fall-out from these emissions, have resulted in releases of lead, cadmium, and sulfur dioxide to the air and soil. Since 1980, the smelter's emissions have been regulated under general and site-specific regulation established in the SIP. Lead emissions at one air monitoring station near the site have consistently been above the 1.5 microgram per cubic meter ($\mu g/m^3$) National Ambient Air Quality Standard (NAAQS), since it was installed in 1992. Due to the continued noncompliance with the NAAQS standard, new SIP regulations are being developed by the site and MDNR.

Soil sampling has shown lead levels as high as 12,800 parts per million (ppm) in the surface soils of homes surrounding the smelter. A 1992 Jefferson County Health Department study identified 13 homes near the site where children had lead levels greater than 15 micrograms per decaliter (µg/dl). Twelve of these 13 homes had lead levels in the soil ranging from 1,000 to 3,500 ppm, and one had lead levels in the soil up to 999 ppm. Thirteen out of 21 birds tested as part of the USFWS study showed clinical or subclinical lead poisoning based on liver analysis. Fish and tissue samples collected during this study had lead concentrations up to 7.5 ppm. Under a groundwater monitoring program conducted at the site since 1980, lead and cadmium concentrations in the groundwater periodically have been found above the respective maximum contaminant levels (MCLs) established under the Safe Drinking Water Act. The MCLs for lead and cadmium are 15 parts per billion (ppb) and 5 ppb, respectively.

In August of 2001, EPA was notified by a Herculaneum citizen of a grey powdery substance on the roads in the town. Further investigation identified the substance containing lead at 300,000 ppm or 30%. Additional field screening identified the trucks delivering lead concentrate to the Doe Run Smelter as the likely source of the material along the haul routes in the town.

1.4 Project/Task Description

The activities described in this QAPP will address the following:

A. The extent of soil contamination in residential yards, day-care facilities, areas in schoolyards frequented by children, parks, and all other child high-use areas affected by the HLS operations located east of and adjacent to U. S. Highway 61 and north of Joachim Creek in the township of Herculaneum. In addition, all residential yards and child high-use areas adjacent to or north of Old Route 61 Highway between the Joachim Creek overpass and U.S. Highway 61 shall be characterized. This includes all residential lots owned by the Doe Run Company and vacant residential lots.

B. If the results of the site characterization along haul routes conducted in item A above indicate that high levels of surface soil contamination exists beyond the boundaries specified, sampling will be conducted to delineate the extent of this contamination in residential yards, day-care facilities, areas in schoolyards frequented by children, parks, and all other high use areas affected by the HLS operations.

1.5 Quality Objectives and Criteria for Measurement Data

The QA objective for this project is to provide valid data of known and documented quality. Specific Data Quality Objectives (DQO's) are discussed in terms of accuracy, precision, completeness, representativeness, and comparability.

For this project, accuracy is defined as the ratio, expressed as a percentage, of a measured value to a true or reference value. The measurement process of a contaminant concentration includes separate field and laboratory measurements. Errors are associated with each of these two types of measurements. These errors will be quantified and expressed as a measure of accuracy. The analytical component of accuracy will be expressed as Percent Recovery based on the analysis of lab-prepared spike samples and Performance Evaluation (PE) audit samples.

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All site personnel will be required to have completed a basic 40-hour health and safety (Hazardous Waste Operations and Emergency Response [HAZWOPER]) training course and annual refreshers. Familiarization with the Niton™ XRF and its operating procedures will also be necessary for the START members.

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START personnel will maintain a field logbook to record all pertinent activities associated with the sampling events. Appropriate documentation pertaining to photographs taken by START will also be recorded in the field logbook. Information pertaining to all samples (i.e., sampling dates/times, locations, etc.) collected during this event will be recorded on sample field sheets generated by START. Labels generated by START will be affixed to sample containers, identifying sample numbers, dates collected, and requested analyses. Chain of custody records will be completed/maintained for all samples from the time of their collection until they are submitted to the laboratory for analysis.

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The characterization sampling will be conducted in a priority hierarchy as follows:

A. Residential yards where a known child under 7 years old resides.

B. Residential yards along the primary and secondary concentrate haul routes.

C. Child high use areas.

At a minimum, residential properties located in the previously identified area will have four quadrants established around the home, which will radiate out 50 feet from each side of the home. In each quadrant, a nine-aliquot composite sample will be collected from the upper 1 inch of soil and screened with a Niton™ XRF. Therefore, a minimum of 4 four samples will be collected from each resedential property. Soil samples will not be collected from within 3 feet of the residential dwellings to reduce the potential lead-based paint contribution to soil-lead concentrations. In addition, multi-aliquot surface soil samples will be taken at the drip line of each structure where a child under 6 years old with elevated blood lead is known to reside. Multi-aliquot surface soil samples will also be collected from any play areas, gardens, sand piles, unpaved driveways, and other areas appearing to be frequented by children. The number of aliquots for these areas will be dependent upon size, but, in general, will follow the aliquot density used for the quadrants.

A 9-aliquot soil sample will be collected from the five-foot section of residential yards and high child use areas adjacent to roads used as haul routes by the Doe Run Company and within the first 50 yards of the streets intersecting with those haul routes.

In addition to soil sampling at residential properties, indoor dust samples will be collected at residential homes which meet the one of the following criteria: 1) homes which have a child less than 6 years of age; and 2) homes which have an XRF screening concentration of greater than 10,000 ppm from any area of the yard.

For locations where there are no residences, a center point, depicting a possible future building site, will be established and flagged. From the center point, four quadrants will be established, which will radiate out 100 feet in each compass direction, and the aforementioned sampling protocols will be completed (e.g. collecting a nine-aliquot composite from each quadrant).

If the results of the screening characterization conducted indicate that surface soil contamination exists (i.e., lead concentrations greater than 400 ppm) beyond the specified limits, further sampling will be conducted on properties beyond the defined sampling.

In addition to soil sampling, four to five ambient air sampling apparatus will be established at several locations near the smelter to determine the potential impact of transporting lead materials from and to the smelter. Specific monitoring locations will be based on field judgment. The monitoring locations will include high traffic and low traffic areas, in order to study any differences. The sampling apparatus will include Hi-Vol and PM-10 Hi-Vol air monitoring instruments. The air monitoring instruments will be placed on the ground. At least one Hi-Vol and one PM-10 Hi-Vol will be collocated at one location.

A summary of anticipated samples to be collected for this project is provided in the following table. The exact number will depend on field screening results, as previously described. Approximately 10 percent of all screening samples will be collected for laboratory confirmation analysis.

	Number of Samples		
Matrix	Field Screening (Lead)	Laboratory	Laboratory Analyses[a]
Soil	4,000	400	Lead, cadmium, arsenic, zinc, nickel
Dust	NA[b]	250	Lead, cadmium, arsenic, zinc, nickel
Air	NA	200	Lead, cadmium, arsenic, zinc, nickel

a. See Section 2.4 for details pertaining to analyses.

b. NA = Not Applicable

2.2 Sampling Methods Requirements

Soil samples will be collected following the EPA Region 7 SOP #2231.12A: ERT #2012; "Soil Sampling". Confirmation soil samples will be collected with a clean, dedicated stainless steel spoon and homogenized in a clean, dedicated aluminum pie pan. The samples will be screened with the XRF after homogenizing the soil, and three consecutive XRF readings will be collected. The three homogenized XRF readings will be recorded on a field sheet. Screening samples using the XRF will follow EPA Region 7 SOP # 4231.707A. The location of the XRF readings (as well as confirmation sample location, if necessary) will also be recorded on each field sheet. Confirmation samples will be transferred directly into the appropriate container for analysis. The samples will be submitted to a subcontracted laboratory.

Indoor dust sampling will be conducted in accordance with EPA Region 7 SOP #4231.11A with a minor modification to include the use of a hand-held electric vacuum sweeper. A dedicated filter will be used for each sample. The dust sample will be collected from an adequate area to provide a minimum of 5 grams of weight. The sampling area will include high traffic areas, children bedrooms, and/or undisturbed areas. Pertinent sampling information will be documented on field sheets. The dust sample will be transferred directly into a dedicated ziplock bag and labeled for laboratory analysis.

All ambient air sampling will be accomplished using Hi-Vol and PM-10 Hi-Vol Air Samplers (manufactured by General Metals Work, Inc., Village of Cleves, Ohio), or equivalent The samplers will be operated in accordance with EPA Region 7 SOP No. 2314.1A and No. 2314.2A except where procedures differ from this QAPP. In all cases, the policies described in this QAPP shall take precedence over other EPA SOPs. Each sampler will be positioned on the ground level. Suitable supporting structures meeting all local and Federal safety codes will be used. Samplers will be operated continuously for a 24-hour (±10%) sampling duration. Sampler start and completion times will be referenced to 2400 hours.

Air samples may be voided by the EPA OSC or START Project Manager under the following conditions: (1) If the sampling duration is outside the 21.6 to 26.4 hour limit; (2) evidence of sample tampering is observed; or (3) sample is known to be unrepresentative (due to contamination. sampler failure, etc.).

One meteorological station will be established for the air monitoring. The station will be sited and operated in accordance with "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV Meteorological Measurements", EPA-600/4-82-060, August 1989. Specifically, the station will measure wind direction, wind speed, and temperature from a height of 10 meters. Data logging will be accomplished electronically using an averaging time of 1 hour. Surface pressure (not corrected to sea level) will be recorded hourly. If larger scale meteorological data are required, such "synoptic" data will be acquired from the nearest US Geological Survey stream recording station or from the nearest reporting airport.

Disposal of investigation-derived wastes (IDW) and procedures for equipment/personal decontamination will be addressed in a site-specific health and safety plan prepared by the Tetra Tech START. In general, it is anticipated that most IDW will consist of disposable sampling supplies (gloves, paper towels, etc.) that will be disposed of off-site as uncontaminated debris.

2.3 Sample Handling and Custody Requirements

Samples will be collected in accordance with procedures defined in Region VII EPA SOP 2130.4B. Chain of custody procedures will be maintained as directed by Region VII EPA SOP 2130.2A. Samples will be accepted by the contracted laboratory according to their specific procedures and SOPs.

All soil sample containers will be placed in plastic bags to control spillage in case the containers break during shipment. Soil and dust samples will be placed in coolers containing packing material and enough ice to ensure that the temperature of the samples does not exceed 4°C. Necessary paperwork for all samples, including chain of custody records, will be completed by the Tetra Tech START and maintained with the coolers until delivery to the laboratory. If shipment of the samples is required via commercial service, each cooler lid will be securely taped shut, and two custody seals will be signed/dated and placed across the lid opening. The samples will be submitted to the receiving laboratory by START personnel in a time-efficient manner to ensure that the applicable holding times are not exceeded.

2.4 Analytical Methods Requirements

The samples will be analyzed at a pre-qualified laboratory contracted by the Tetra Tech START, according to the EPA methods listed in the following table. Detection limits that are typically reported by those methods are expected to be adequate for this activity. The requested analyses have been selected based on past sampling data and historical information collected for the site:

ANALYTICAL METHODS	
Analytical Parameter[a]	EPA Method Number
	SOIL/DUST
Lead, cadmium, arsenic, zinc, nickel	SW846 Method 6010B
	AIR
Lead, cadmium, arsenic, zinc, nickel	SW846 Method 6010 B and 7000 Series

a. EPA may cease the analysis for zinc and nickel content if zinc and nickel concentrations in the initial confirmation samples are consistently below MDNR's Any Use Soil Levels.

2.5 Quality Control Requirements

Because dedicated supplies will be used for all samples (i.e., stainless steel spoons, pie pans, etc.), no QC samples will be required to assess the potential for cross-contamination. Analytical error (precision and accuracy) will be determined by the analysis of laboratory-prepared duplicates and spike samples. These criteria, along with other laboratory QC elements, will be performed in accordance with the contract laboratory's quality assurance plan.

To satisfy the quality control elements for the XRF, data will be collected and analyzed for comparability to laboratory data, to determine detection and quantitation limits, and to determine accuracy and precision. The mean of the three XRF readings taken for each confirmation sample will be compared statistically to the laboratory results for each confirmation sample to assess comparability. The measure of agreement (r^2) for the XRF unit should be above 0.7 or greater for the XRF data to be considered screening level data.

For every measurement, the Niton™ gives an uncertainty range that represents a 95 percent confidence interval. In general, precision/accuracy increases with increasing sample run time. Due to preliminary sample results indicating high lead levels, XRF sample run time will be increased accordingly to improve precision and accuracy. The goal is for samples to be screened long enough to obtain precision measurements within 20% of the actual concentrations.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Testing, inspection, and maintenance of all sampling equipment and supplies, along with field screening instrumentation, will be performed by START personnel prior to deployment for field activities. Testing, inspection, and maintenance of analytical instrumentation will be performed in accordance with the contracted laboratory's analytical SOPs and manufacturers' recommendations.

2.7 Instrument Calibration and Frequency

Calibration of the field screening and laboratory analytical instrumentation will be in accordance with the referenced SOPs and manufacturers' recommendations.

2.8 Inspection/Acceptance Requirements for Supplies and Consumables

All sample containers will meet EPA criteria for cleaning procedures required for low-level chemical analysis. Sample containers will have Level II certifications provided by the manufacturer in accordance with pre-cleaning criteria established by EPA in *Specifications and Guidelines for Obtaining Contaminant-Free Sample Containers*. The certificates of cleanliness will be maintained in the project file.

2.9 Data Acquisition Requirements

Previous data/information pertaining to the site (including other analytical data, reports, photos, maps, etc., which are referenced in this QAPP) have been compiled by START from various sources. Some of that data has not been verified; however, that information will not be used for decision-making purposes without verification of its authenticity.

2.10 Data Management

All laboratory data will be managed as specified in the contract laboratory's QAM. Preliminary data will be received by the project manager on site. The final data package will be forwarded to a chemist trained in data validation to complete the validation process. The results will be summarized and included in the report submitted to EPA. .

3. ASSESSMENT/OVERSIGHT

3.1 Assessments and Response Actions

Assessment and response actions pertaining to analytical phases of the project are addressed in the contracted laboratory's quality assurance manual(s). Because of the short duration of this sampling event, no field audits of sampling procedures will be performed. Corrective actions will be taken at the discretion of the EPA Project Manager, whenever there appears to be problems that could adversely affect data quality and/or resulting decisions affecting future response actions pertaining to the site.

3.2 Reports to Management

A letter report describing the sampling techniques, locations, problems encountered (with resolutions to those problems), and interpretation of analytical results will be prepared by START, following completion of the field activities described herein and validation of laboratory data. The laboratory data for soil samples will be compared to all applicable or relevant and appropriate requirements (ARARs), including removal action levels that have been established for the site, to determine whether further response is warranted.

4. DATA VALIDATION AND USABILITY

4.1 Data Review, Validation, and Verification Requirements

Data review and verification will be performed by a qualified laboratory analyst and the laboratory's section manager in accordance with the contracted lab's quality assurance program. Follow-up validation of the data will be performed by a Tetra Tech START chemist. The START Project Manager will be responsible for overall validation and final approval of the data, in accordance with the projected use of the results.

4.2 Validation and Verification Methods

A qualified Tetra Tech START chemist will review the data for laboratory spikes/duplicates and laboratory blanks to ensure that they are acceptable. The START Project Manager will inspect the data to provide a final review. The START Project Manager will also compare the sample descriptions with the field sheets for consistency and will ensure that any anomalies in the data are appropriately documented.

4.3 Reconciliation With User Requirements

If data quality indicators do not meet the project's requirements as outlined in this QAPP, the data may be discarded, and re-sampling and/or re-analysis may be required.

ATTACHMENT A

Figure 1: Site Location Map

(One page)

Herculaneum Lead Smelter
Herculaneum, Missouri

Figure 1
Site Location Map

Not to Scale

Tetra Tech EM Inc.

rce: USGS Festus MO 7.5 Minute Topo Quad

ATTACHMENT B

Figure 2: Aerial Photography

(One page)

Not to Scale

Herculaneum Lead Smelter
Herculaneum, Missouri

Figure 2
Aerial Photography

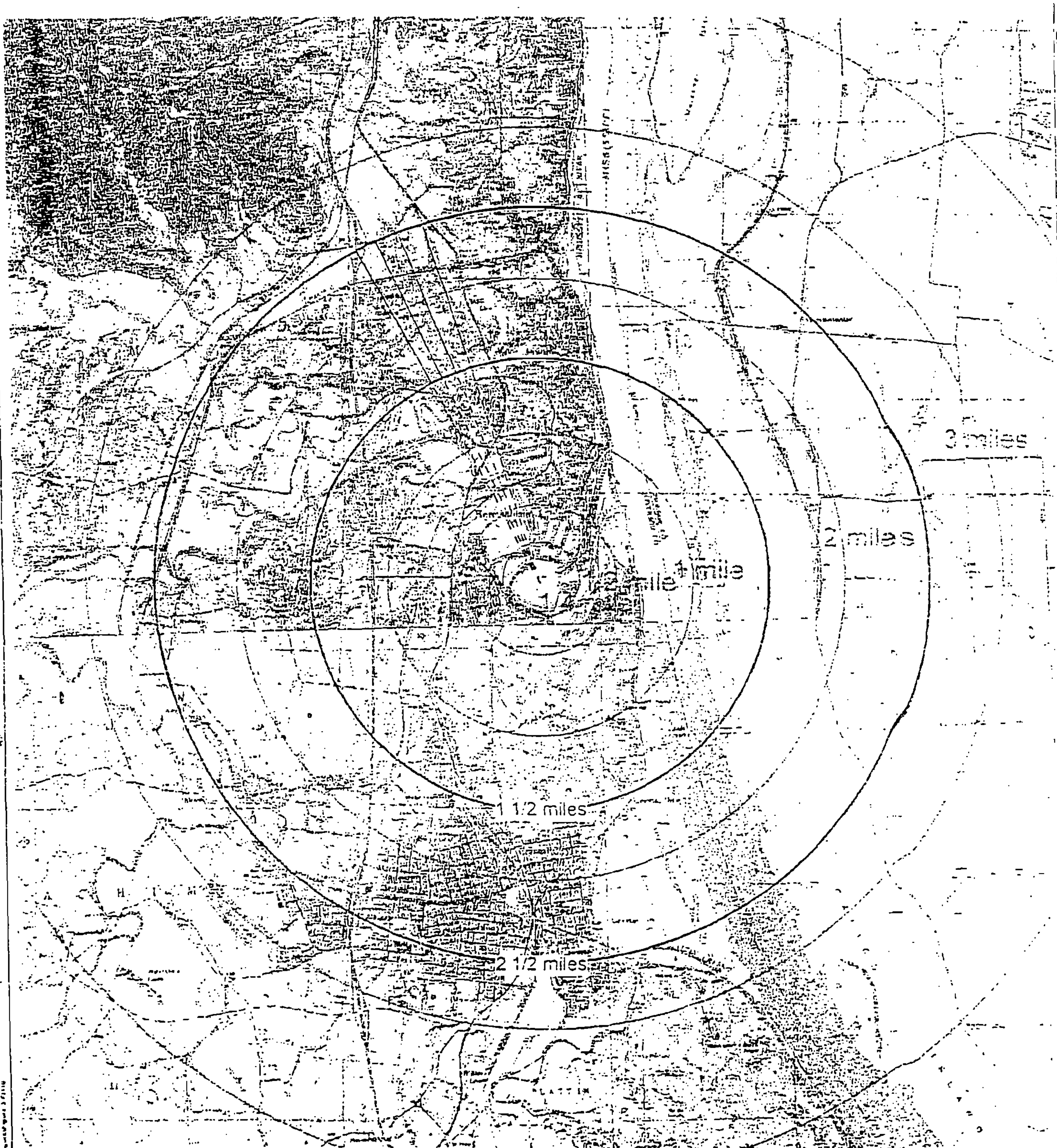
Tetra Tech EM Inc.

rce: USGS Aerial Photo & CARES Internet Map Server, *University of Missouri-Columbia*

ATTACHMENT C

Figure 3: Sampling Map

(One page)



Legend

Radius rings

Transect lines

Transect lines where sampling will occur

Note: Samples will be taken every 200 hundred feet along the transect lines between the 1 1/2 miles radius ring and the 2 1/2 miles radius ring.

Source: USGS Festus, MO 7.5 Minute Topo Quad

Not to Scale

Herculaneum Lead Smelter
Herculaneum, Missouri

Figure 3
Sampling Map

Tetra Tech EM Inc.

TAB 13

QUALITY ASSURANCE PROJECT PLAN

FOR A

SITE CHARACTERIZATION AT THE HERCULANEUM LEAD SMELTER

HERCULANEUM, MISSOURI
CERCLIS ID NO.: MOD006266373

Prepared For:

U.S. Environmental Protection Agency Region VII
Superfund Division
901 North 5th Street
Kansas City, Kansas 66101

Prepared By:

USEPA Region VII Superfund Technical Assessment and Response Team (START) 2

September 10, 2001

APPROVED BY:

for	9/11/01
START Project Manager, Ryan Schuler	Date
	9/11/01
START Program Manager, Hieu Q. Vu, PE, CHMM	Date
	9-11-01
EPA Project Manager, Superfund Division, Joe Davis	Date
Robert B Dona	10/01/01
EPA Superfund Quality Assurance Coordinator, Bob Dona	Date

G9011/010027.00

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ATTACHMENTS

1.0 PROJECT MANAGEMENT

1.1 DISTRIBUTION LIST

Region VII EPA	Joe Davis, USEPA Project Manager Bob Dona, USEPA SuperFund Quality Assurance Coordinator
Region VII START	Ryan Schuler, START Project Manager Hieu Q. Vu, START Program Manager Ted Faile, START Quality Assurance Manager

1.2 PROJECT/TASK ORGANIZATION/SCOPE OF WORK

Ryan Schuler, of the U.S. Environmental Protection Agency (USEPA) Region VII Superfund Technical Assessment and Response Team (START), will serve as the START Project Manager for the activities described in this Quality Assurance Project Plan (QAPP) to be conducted at the Herculaneum Lead Smelter Site in Herculaneum, Missouri. He will be responsible for overall coordination of site activities, ensuring implementation of the QAPP, and providing periodic updates to the client concerning the status of the project, as needed. Joe Davis will be the USEPA Project Manager for this activity.

Eight to ten START members will comprise the field/sampling team. The team will be responsible for assisting EPA with surveying activities, obtaining access to sampling properties, acquisition and calibration of sampling equipment, sample collection, field screening, documentation of residential property conditions and field activities, and coordination of laboratory analyses. The START Quality Assurance (QA) Manager will provide technical assistance, as needed, to ensure that necessary QA issues are adequately addressed.

This QAPP was prepared to address site characterization to determine the extent of soil contamination caused by operations at the Herculaneum Lead Smelter (HLS) site in Herculaneum, Missouri. In addition, air monitoring stations will be established to document fugitive releases of airborne contaminants. The scope of work includes obtaining property access, surveying/marking sampling cells at each property, collection of surface soil samples for field screening and laboratory analyses, and collection of ambient air samples at several locations near the HLS site.

Although an attempt will be made to adhere to this QAPP as much as possible, the proposed activities may be altered in the field if warranted by site-specific conditions and/or unforeseen hindrances that prevent any aspect of this QAPP from being implemented in a feasible manner. Such deviations will be recorded in the site logbook as necessary. This QAPP will be available to the field team(s) at all times during sampling activities to serve as a key reference for the proposed activities described herein.

1.3 PROBLEM DEFINITION/BACKGROUND/SITE DESCRIPTION

This QAPP was prepared by the Tetra Tech START to address imminent and long-term concerns that could impact human health and/or the environment at the HLS site (site), where metals-contaminated soils (predominantly lead, cadmium and zinc) have been identified during previous sampling activities.

The HLS site is located at 881 Main Street in Herculaneum, Missouri, about 25 miles south of the St. Louis metropolitan area (see Attachment A - Figure 1: Site Location Map). The site property is approximately 52 acres in size. An approximately 24-acre slag disposal pile is located south of the smelter in a horseshoe bend of Joachim Creek. The slag pile is located in the floodplain of Joachim Creek, in an area classified as a wetland. The smelter site is bordered on the east by the Mississippi River and on the north and west by residential areas. South of the smelter is the slag pile and wetland area. The slag pile is bordered to the east, west, and south by Joachim Creek, and to the north by residential areas and the smelter facility (see Attachment B - Figure 2: Aerial Photography). The slag pile and most of the smelter facility are located in Jefferson County, Section 29, T. 41 N., R.6 E., although the northern portion of the facility extends into Section 20. Geographic coordinates of the site are 38° 15' 19.0" north latitude and 90° 22' 56.7" west longitude.

The site is an active lead smelter, the largest of its kind in the United States. HLS began operations in 1892 as part of the St. Joseph Lead Company. In 1986, it became part of the newly formed Doe Run Company (Doe Run), a joint venture of the Fluor Corporation and the Homestake Mining Company. In 1990, the Fluor Corporation became the sole owner of Doe Run. The site consists of three main areas: (1) the smelter plant, located on the east side of Main Street; (2) the slag storage pile; and (3) office buildings on the west side of Main Street.

The following major processes occur at the HLS site: (1) sintering, smelting, and refining of lead ore; (2) sulfuric acid production from waste sulfur-containing gases generated by the sintering operation; and

(3) wastewater treatment. The smelting operation generates a molten slag, 20 percent of which is sent to a slag storage pile as waste. The slag pile occupies approximately 24 acres in the floodplain of Joachim Creek, and is up to 40 feet tall in some sections. In 1993, during a major flood event, water reached several feet up the sides of the slag pile. The site also generates stack air emissions from the smelter and fugitive air emissions from various operations (MDNR, 1999).

Several investigations have been conducted at the site, including a Preliminary Assessment/ Screening Site Inspection by the EPA in 1980, a multimedia compliance inspection by the EPA in 1995, a Preliminary Ecological Risk Assessment for Fish and Wildlife Habitats by the U.S. Fish and Wildlife Service (USFWS) in 1998, and a Preliminary Assessment by the Missouri Department of Natural Resources (MDNR) in 1998 and 1999. In addition to these state and federal lead investigations, the facility has collected and submitted to the state a large quantity of environmental data pursuant to Missouri's site-specific State Implementation Plan (SIP) established under the Clean Air Act (CAA), National Pollutant Discharge Elimination System (NPDES) permit, Metallic Minerals Waste Management Act permit, and voluntary soil cleanup efforts in the surrounding Herculaneum community.

Based on previous investigations, primary metal contaminants in the slag pile include arsenic, cadmium, copper, lead, nickel, and zinc. The slag pile has been partially inundated by flood waters in the past. The USFWS identified significant concentrations of lead, cadmium, and zinc in floodplain soils; significant concentrations of lead and zinc in river sediments; and significant zinc concentrations in surface water samples collected from drainage ditches on the Joachim Creek floodplain.

Stack and fugitive emissions from the site, and fall-out from these emissions, have resulted in releases of lead, cadmium, and sulfur dioxide to the air and soil. Since 1980, the smelter's emissions have been regulated under general and site-specific regulation established in the SIP. Lead emissions at one air monitoring station near the site have consistently been above the 1.5 microgram per cubic meter ($\mu g/m^3$) National Ambient Air Quality Standard (NAAQS), since it was installed in 1992. Due to the continued noncompliance with the NAAQS standard, new SIP regulations are being developed by the site and MDNR.

Soil sampling has shown lead levels as high as 12,800 parts per million (ppm) in the surface soils of homes surrounding the smelter. A 1992 Jefferson County Health Department study identified 13 homes near the site where children had lead levels greater than 15 micrograms per decaliter (µg/dl). Twelve of these 13 homes had lead levels in the soil ranging from 1,000 to 3,500 ppm, and one had lead levels in the soil up to 999 ppm. Thirteen out of 21 birds tested as part of the USFWS study showed clinical or subclinical lead poisoning based on liver analysis. Fish and tissue samples collected during this study had lead concentrations up to 7.5 ppm. Under a groundwater monitoring program conducted at the site since 1980, lead and cadmium concentrations in the groundwater periodically have been found above the respective maximum contaminant levels (MCLs) established under the Safe Drinking Water Act. The MCLs for lead and cadmium are 15 parts per billion (ppb) and 5 ppb, respectively.

1.4 PROJECT/TASK DESCRIPTION

The activities described in this QAPP will address the following:

1. The extent of soil contamination in residential yards, day-care facilities, areas in schoolyards frequented by children, parks, and all other high-use areas affected by the HLS operations ~~beyond a 0.4-mile radius of the smelter, but~~ within a 1-mile radius of the smelter on non-company owned properties on the Missouri side of the Mississippi River. OK

2. If the results of the site characterization conducted in item #1 above indicate that surface soil contamination exists beyond the limits specified, sampling will be conducted to delineate the extent of soil contamination in residential yards, day-care facilities, areas in schoolyards frequented by children, parks, and all other high use areas affected by the HLS operations beyond a 1-mile radius of the smelter, but within a 1 ½ mile radius of the smelter on non-company owned properties on the Missouri side of the Mississippi River. If the results of the site characterization conducted indicate that surface soil contamination exists beyond the limits specified, further site characterization of properties beyond a 1 ½ mile radius of the smelter may be required.

3. The extent of soil contamination in residential properties extending from the smelter facility, beyond the 1 ½ mile radius of the smelter, using a linear transect sampling approach. This sampling will be conducted outward from a 1 ½ mile radius of the smelter facility's smokestack, in the areas with the highest density of residential properties.

4. The potential fugitive release of contaminants due to trucking/transportation at the smelter and any impact on residential homes.

The EPA has determined that the criteria for deciding whether or not to expand the soil characterization areas shall be based on surface soil concentrations of lead, zinc, and cadmium exceeding risk-based action levels calculated using the Integrated Exposure Uptake Biokinetic model. However, until such levels are determined, lead concentration in soil of 400 mg/kg (or ppm) will be used as a base for determining further characterization of properties. To achieve the aforementioned objectives, samples of surface soil will be collected throughout the Herculaneum community. Relevant aspects of the project are described in the following sections of this QAPP.

1.5 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The QA objective for this project is to provide valid data of known and documented quality. Specific Data Quality Objectives (DQO's) are discussed in terms of accuracy, precision, completeness, representativeness, and comparability.

For this project, accuracy is defined as the ratio, expressed as a percentage, of a measured value to a true or reference value. The measurement process of a contaminant concentration includes separate field and laboratory measurements. Errors are associated with each of these two types of measurements. These errors will be quantified and expressed as a measure of accuracy. The analytical component of accuracy will be expressed as Percent Recovery based on the analysis of lab-prepared spike samples and Performance Evaluation (PE) audit samples.

Precision for this project is defined as a measure of agreement among individual measurements of the same property and will be expressed via duplicate samples. The overall precision is assessed by collection of duplicate or collocated samples. Approximately 10% of duplicate/collocated samples is anticipated.

Data completeness will be expressed as the percentage of data generated that is considered valid. A completeness goal of 100% will be applied to this project; however, if that goal is not met, site decisions may still be made based on the remaining data. No specific critical samples have been identified for the project.

Representativeness of collected samples is facilitated by establishing and following criteria and procedures identified in this QAPP.

Data comparability is achieved by requiring all data generated for the project be reported in common units. The following table lists the various types of data that will be generated and the specific reporting units.

SPECIFIC DATA REPORTING UNITS	
PARAMETER	**UNIT**
Metals in Soil by X-ray Fluorescence Spectrometer (XRF)	ppm
Metals in Soil by Laboratory Analysis	milligrams per kilogram (mg/kg)
Metals in Air	micrograms per cubic meter ($\mu g/m^3$)
Sampled Air Volume at Standard Temperature and Pressure (STP)	cubic meters at STP (m^3 STP)
Sampling Flowrate at STP	cubic meters per minute at STP (m^3/min STP)
Wind Speed	miles per hour (mph)
Wind Direction (Field Report)	degrees on an azimuth compass
Temperature	degrees Farenheit (°F)
Barometric Pressure (not corrected to sea level)	millimeters of mercury (mm Hg)
Time	military time (00:00 - 24:00)
Date	month/day/year

1.6 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

All site personnel will be required to have completed a basic 40-hour health and safety (Hazardous Waste Operations and Emergency Response [HAZWOPER]) training course and annual refreshers. Familiarization with the Niton™ XRF and its operating procedures will also be necessary for the START members.

1.7 DOCUMENTATION AND RECORDS

START personnel will maintain a field logbook to record all pertinent activities associated with the sampling events. Appropriate documentation pertaining to photographs taken by START will also be recorded in the field logbook. Information pertaining to all samples (i.e., sampling dates/times, locations, etc.) collected during this event will be recorded on sample field sheets generated by START. Labels generated by START will be affixed to sample containers, identifying sample numbers, dates collected, and requested analyses. Chain of custody records will be completed/maintained for all samples from the time of their collection until they are submitted to the laboratory for analysis.

A health and safety plan will be prepared by START prior to the field activities that will address site-specific hazards. The health and safety plan will be reviewed and signed by all field personnel prior to field work, indicating that they understand the plan and its requirements. Copies of the plan will be available to all personnel throughout the sampling activities.

2.0 MEASUREMENT/DATA ACQUISITION

2.1 SAMPLING PROCESS DESIGN

The proposed sampling scheme for this project will be in accordance with the Removal Program Representative Sampling Guidance, Volume 1: Soil, OSWER Directive 9360.4-10, November 1991, and judgmental (based on the best professional judgement of the sampling team). The sampling design proposed in the following paragraphs has been selected to identify the extent of soil contamination at the site. The proposed number of samples is a balance between cost and coverage and represents a reasonable attempt to meet the study objectives while staying within the budget constraints of a typical site investigation.

For residential properties located between a 0.4 mile and 1-mile radius of the smelter, four quadrants will be established around the home, which will radiate out 50 feet from each side of the home. In each quadrant, a nine-aliquot composite sample will be collected from the upper 1 inch of soil and screened with a Niton™ XRF. Soil samples will not be collected from within 3 feet of the residential dwellings to reduce the potential lead-based paint contribution to soil-lead concentrations. In addition, multi-aliquot surface soil samples will be taken at the drip line of each structure where a child under 6 years old with elevated blood lead resides. Multi-aliquot surface soil samples will also be collected from any play areas and gardens, sand piles, unpaved driveways, and other areas appearing to have been used by children. The number of aliquots for these areas will be dependent upon size, but, in general, will follow the aliquot density used for the quadrants.

In addition to soil sampling at residential properties, indoor dust samples will be collected at residential homes which meet the one of the following criteria: 1) homes which have a child with blood lead level greater than 10 (μg/dl); 2) homes which have a child less than 7 years of age; and 3) homes which have XRF screening concentrations of greater than 10,000 ppm (excluding XRF concentrations from the drip line).

ok

For locations where there are no residences, a center point, depicting a possible future building site, will be established and flagged. From the center point, four quadrants will be established, which will radiate out 100 feet in each compass direction, and the aforementioned sampling protocols will be completed (e.g. collecting a nine-aliquot composite from each quadrant).

If the results of the screening characterization conducted indicate that surface soil contamination exists (i.e., lead concentrations greater than 400 ppm) beyond the specified limits, further sampling will be conducted on properties between a 1- and 1 ½-mile radius of the smelter. If the results of that screening characterization still indicate that surface soil contamination exists beyond the 1 ½ mile radius of the smelter, further sampling on residential properties located beyond the specified limits may be required, using the same sampling design.

Linear transects will be established from the 1 ½ mile perimeter of the smelter facility's smokestack in areas with highest density of residential properties. The transects will extend 1 mile from the established perimeter. Grab samples will be collected every 200 feet along the transects, if possible, and screened with a Niton™ XRF. The first transects selected for sampling will be along axes parallel or near parallel to the prevailing downwind directions (see Attachment C - Figure 3: Sampling Map). If the results of the screening characterization conducted indicate that surface soil contamination exists (i.e., lead concentrations greater than 400 ppm) beyond the 1-mile transects, further sampling on residential properties beyond the 1-mile transects may be required.

In addition to soil sampling, four to five ambient air sampling apparatus will be established at several locations near the smelter to determine the potential impact of transporting lead materials from and to the smelter. Specific monitoring locations will be based on judgmental. The monitoring locations will include high traffic and low traffic areas, in order to study any differences. The sampling apparatus will include Hi-Vol and PM-10 Hi-Vol air monitoring instruments. The air monitoring instruments will be placed on the ground. At least one Hi-Vol and one PM-10 Hi-Vol will be collocated at one location.

A summary of anticipated samples to be collected for this project is provided in the following table. The exact number will depend on field screening results, as previously described. Approximately 10 percent of all screening samples will be collected for laboratory confirmation analysis.

Matrix	Number of Samples		Laboratory Analyses[1]
	Field Screening (Lead)	Laboratory	
Soil	4000	400	Lead, cadmium, arsenic, zinc, nickel
Dust	NA	400	Lead, cadmium, arsenic, zinc, nickel
Air	NA	5	Lead, cadmium, arsenic, zinc, nickel

NA = Not Applicable
[1] See Section 2.4 for details pertaining to analyses.

2.2 SAMPLING METHODS REQUIREMENTS

Soil samples will be collected following the EPA Region 7 SOP #2231.12A: ERT #2012; "Soil Sampling". Confirmation soil samples will be collected with a clean, dedicated stainless steel spoon and homogenized in a clean, dedicated aluminum pie pan. The samples will be screened with the XRF after homogenizing the soil, and three consecutive XRF readings will be collected. The three homogenized XRF readings will be recorded on a field sheet. Screening samples using the XRF will follow EPA Region 7 SOP # 4231.707A. The location of the XRF readings (as well as confirmation sample location, if necessary) will also be recorded on each field sheet. Confirmation samples will be transferred directly into the appropriate container for analysis. The samples will be submitted to a subcontracted laboratory.

Indoor dust sampling will be conducted in accordance with EPA Region 7 SOP #4231.11A with a minor modification to include the use of a hand-held electric vacuum sweeper. A dedicated filter will be used for each sample. The dust sample will be collected from an adequate area to provide a minimum of 5 grams of weight. The sampling area will include high traffic areas, children bedrooms, and/or undisturbed areas. Pertinent sampling information will be documented on field sheets. The dust sample will be transferred directly into a dedicated ziplock bag and labeled for laboratory analysis.

All ambient air sampling will be accomplished using Hi-Vol and PM-10 Hi-Vol Air Samplers (manufactured by General Metals Work, Inc., Village of Cleves, Ohio), or equivalent The samplers will be operated in accordance with EPA Region 7 SOP No. 2314.1A and No. 2314.2A except where procedures differ from this QAPP. In all cases, the policies described in this QAPP shall take precedence over other EPA SOPs. Each sampler will be positioned on the ground level. Suitable supporting structures meeting all local and Federal safety codes will be used. Samplers will be operated continuously for a 24-hour (±10%) sampling duration. Sampler start and completion times will be referenced to 2400 hours.

Air samples may be voided by the EPA OSC or START Project Manager under the following conditions: (1) If the sampling duration is outside the 21.6 to 26.4 hour limit; (2) evidence of sample tampering is observed; or (3) sample is known to be unrepresentative (due to contamination, sampler failure, etc.).

One meteorological station will be established for the air monitoring. The station will be sited and operated in accordance with "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV Meteorological Measurements", EPA-600/4-82-060, August 1989. Specifically, the station will measure wind direction, wind speed, and temperature from a height of 10 meters. Data logging will be accomplished electronically using an averaging time of 1 hour. Surface pressure (not corrected to sea level) will be recorded hourly. If larger scale meteorological data are required, such "synoptic" data will be acquired from the nearest US Geological Survey stream recording station or from the nearest reporting airport.

Disposal of investigation-derived wastes (IDW) and procedures for equipment/personal decontamination will be addressed in a site-specific health and safety plan prepared by the Tetra Tech START. In general, it is anticipated that most IDW will consist of disposable sampling supplies (gloves, paper towels, etc.) that will be disposed of off-site as uncontaminated debris.

2.3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Samples will be collected in accordance with procedures defined in Region VII EPA SOP 2130.4B. Chain of custody procedures will be maintained as directed by Region VII EPA SOP 2130.2A. Samples will be accepted by the contracted laboratory according to their specific procedures and SOPs.

All soil sample containers will be placed in plastic bags to control spillage in case the containers break during shipment. Soil and dust samples will be placed in coolers containing packing material and enough ice to ensure that the temperature of the samples does not exceed 4°C. Necessary paperwork for all samples, including chain of custody records, will be completed by the Tetra Tech START and maintained with the coolers until delivery to the laboratory. If shipment of the samples is required via commercial service, each cooler lid will be securely taped shut, and two custody seals will be signed/dated and placed across the lid opening. The samples will be submitted to the receiving laboratory by START personnel in a time-efficient manner to ensure that the applicable holding times are not exceeded.

2.4 ANALYTICAL METHODS REQUIREMENTS

The samples will be analyzed at a pre-qualified laboratory contracted by the Tetra Tech START, according to the EPA methods listed in the following table. Detection limits that are typically reported by those methods are expected to be adequate for this activity. The requested analyses have been selected based on past sampling data and historical information collected for the site:

ANALYTICAL METHODS	
Analytical Parameter [1]	**EPA Method Number**
SOIL/DUST	
Lead, cadmium, arsenic, zinc, nickel	SW846 Method 6010B
AIR	
Lead, cadmium, arsenic, zinc, nickel	SW846 Method 6010 B and 7000 Series

[1] EPA may cease the analysis for zinc and nickel content if zinc and nickel concentrations in the initial confirmation samples are consistently below MDNR's Any Use Soil Levels.

2.5 QUALITY CONTROL REQUIREMENTS

Because dedicated supplies will be used for all samples (i.e., stainless steel spoons, pie pans, etc.), no QC samples will be required to assess the potential for cross-contamination. Analytical error (precision and accuracy) will be determined by the analysis of laboratory-prepared duplicates and spike samples. These criteria, along with other laboratory QC elements, will be performed in accordance with the contract laboratory's quality assurance plan.

To satisfy the quality control elements for the XRF, data will be collected and analyzed for comparability to laboratory data, to determine detection and quantitation limits, and to determine accuracy and precision. The mean of the three XRF readings taken for each confirmation sample will be compared statistically to the laboratory results for each confirmation sample to assess comparability. The measure of agreement (r^2) for the XRF unit should be above 0.7 or greater for the XRF data to be considered screening level data.

For every measurement, the Niton™ gives an uncertainty range that represents a 95 percent confidence interval. In general, precision/accuracy increases with increasing sample run time. For very high (greater than 1,000 ppm) or very low (less than 300 ppm) concentrations, the sample run time will only be long enough to obtain readings within 30% of the actual concentrations. Otherwise, samples will be screened long enough to obtain precision measurements within 20% of the actual concentrations.

2.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

Testing, inspection, and maintenance of all sampling equipment and supplies, along with field screening instrumentation, will be performed by START personnel prior to deployment for field activities. Testing, inspection, and maintenance of analytical instrumentation will be performed in accordance with the contracted laboratory's analytical SOPs and manufacturers' recommendations.

2.7 INSTRUMENT CALIBRATION AND FREQUENCY

Calibration of the field screening and laboratory analytical instrumentation will be in accordance with the referenced SOPs and manufacturers' recommendations.

2.8 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

All sample containers will meet EPA criteria for cleaning procedures required for low-level chemical analysis. Sample containers will have Level II certifications provided by the manufacturer in accordance with pre-cleaning criteria established by EPA in *Specifications and Guidelines for Obtaining Contaminant-Free Sample Containers.* The certificates of cleanliness will be maintained in the project file.

2.9 DATA ACQUISITION REQUIREMENTS

Previous data/information pertaining to the site (including other analytical data, reports, photos, maps, etc., which are referenced in this QAPP) have been compiled by START from various sources. Some of that data has not been verified; however, that information will not be used for decision-making purposes without verification of its authenticity.

2.10 DATA MANAGEMENT

All laboratory data will be managed as specified in the contract laboratory's QAM. Preliminary data will be received by the project manager on site. The final data package will be forwarded to a chemist trained in data validation to complete the validation process. The results will be summarized and included in the report submitted to EPA.

3.0 ASSESSMENT/OVERSIGHT

3.1 ASSESSMENTS AND RESPONSE ACTIONS

Assessment and response actions pertaining to analytical phases of the project are addressed in the contracted laboratory's quality assurance manual(s). Because of the short duration of this sampling event, no field audits of sampling procedures will be performed. Corrective actions will be taken at the discretion of the EPA Project Manager, whenever there appears to be problems that could adversely affect data quality and/or resulting decisions affecting future response actions pertaining to the site.

3.2 REPORTS TO MANAGEMENT

A letter report describing the sampling techniques, locations, problems encountered (with resolutions to those problems), and interpretation of analytical results will be prepared by START, following completion of the field activities described herein and validation of laboratory data. The laboratory data for soil samples will be compared to all applicable or relevant and appropriate requirements (ARARs), including removal action levels that have been established for the site, to determine whether further response is warranted.

4.0 DATA VALIDATION AND USABILITY

4.1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

Data review and verification will be performed by a qualified laboratory analyst and the laboratory's section manager in accordance with the contracted lab's quality assurance program. Follow-up validation of the data will be performed by a Tetra Tech START chemist. The START Project Manager will be responsible for overall validation and final approval of the data, in accordance with the projected use of the results.

4.2 VALIDATION AND VERIFICATION METHODS

A qualified Tetra Tech START chemist will review the data for laboratory spikes/duplicates and laboratory blanks to ensure that they are acceptable. The START Project Manager will inspect the data to provide a final review. The START Project Manager will also compare the sample descriptions with the field sheets for consistency and will ensure that any anomalies in the data are appropriately documented.

4.3 RECONCILIATION WITH USER REQUIREMENTS

If data quality indicators do not meet the project's requirements as outlined in this QAPP, the data may be discarded, and re-sampling and/or re-analysis may be required.

Technical Report for Focus Group Recommendations

Herculaneum, MO

October 6, 2003

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Focus Group Report

Contents

1. Background

A. Site Background (From SOW for - **Contract No. 68-S7-01-41, Task Order 0108)**

The Herculaneum Lead Smelter, located approximately 25 miles south of the St. Louis metropolitan area in Herculaneum, Missouri, is an active lead smelter that began its operations in 1892. Many studies have been conducted to help characterize the impact the smelter has had, or is currently having, on the surrounding community of Herculaneum, Missouri. Both past and present studies have indicated lead levels that exceed the current cleanup level for soil. This soil cleanup level is sometimes exceeded by more than 300 times. Current studies have shown that the road dust along haul routes contains extremely high concentrations of lead, which are of greatest concentration along the routes bringing lead ore to the smelter. These levels decrease in concentration as one moves away from the smelter along the routes taken by the empty trucks. In some instances, the lead concentration in road dust exceeded 190,000 milligrams per kilogram (mg/kg).

In addition to high levels of lead found in soil and road dust, several children have exhibited elevated blood lead levels (EBL). To help reduce the children's risk of exposure to lead, the soil from several yards were excavated and replaced with soil with lead levels below 240 mg/kg (mg/kg = ppm). The first groups of yards excavated were those surrounding homes with children exhibiting EBL. Eventually, all homes with soil lead concentrations above 400 mg/kg will be excavated.

For the surrounding community of Herculaneum, Missouri, cleanup or action levels were established for air, soil, and interior floor dust wipe and interior windowsill dust wipe samples. No levels were established for road dust or indoor carpet dust samples. The soil cleanup level of 400 mg/kg was established using the EPA Region 9 Preliminary Remediation Goals. The air action level of 1.5 micrograms per cubic meter (μg/m) was established using the National Ambient Air Quality Standards. The interior floor dust wipe cleanup level of 40 micrograms per square foot (μg/ft2) and interior windowsill dust wipe cleanup level of 250 μg/ft2 were established using standards developed by the Department of Housing and Urban Development (HUD). The HUD standards are based on protocols established for lead-based paint cleanup. Because these levels do not account for lead arising from sources other than lead-based paint, such as lead smelter activities, Tetra Tech START was tasked to coordinate the establishment of a proposed set of site-specific, scientifically-based interior lead dust cleanup levels. These proposed levels are to be developed by lead dust experts, with input from a Focus Group which would consist of members of the community, several federal and state agencies, and the potential responsible party.

B. Focus Group Objectives

EPA will engage members of the community; lead dust experts; and representatives from the Missouri Department of Natural Resources (MDNR), Missouri Department of Health and Senior Services, (MDHSS), Agency for Toxic Substances and Disease Registry (ATSDR), Jefferson

County Health Department, and the Doe Run Company to participate in the observation of the development of a site-specific, health-based, cleanup standard and action strategy for lead dust contamination present in home interiors:

i. Identify, provide and review critical and relevant studies on interior lead dust.
ii. Provide and review site-specific environmental data.
iii. Recommend site-specific health-based indoor dust cleanup level goals.
iv. Recommend site-specific sampling protocols.

2. Recommended Site-Specific Interior Cleanup Level -

Background

In developing a recommendation for site-specific, scientifically-based dust lead clean-up levels for Herculaneum, one of the factors to consider is the considerable scientific evidence that the current US EPA standard of 40 $\mu g/ft^2$ for floors is too high to ensure that less than 5% of the children have a blood level greater than 10 $\mu g/dl$ (Lanphear et al, 1998). Additional evidence is from the Big River Site, a lead mining area of Missouri (Sterling et al, 1999). Another major consideration is that the EPA standard was designed to deal primarily with houses where lead-based paint (LBP) is the primary lead source. In Herculaneum, in addition to the lead-based paint that has been detected in some of the houses, there is also the additional source associated with the lead smelter activities. A portion of the exposure from smelter-related activities has been through the air for over 100 years. Fallout from these emissions has built-up in the soil and other deposition locations over time. Although lead from smelter emissions is apparently on the decline, Herculaneum has an historical environmental burden that has accumulated when the air lead levels and other emissions were considerably higher than at present.

An additional more recent lead source is spillage from ore concentrate that is now being trucked to the smelter on haulage roads that pass through residential areas of Herculaneum. We feel this is a major contribution to indoor dust based on: the lead speciation report by Johnson and Abraham (2002) indicating that the majority of house dust is derived from the soil and road; and the bioavailability report by Casteel et al. (2001) indicating that the ore concentrate was found to be an estimated 71% as bioavailable as the lead in lead acetate. In addition, the available dust lead data from the Herculaneum site exhibits a strong correlation of house dust lead with distance from smelter. House dust lead loading decreased as distance from smelter increased. For example, levels at one-half mile were about one-half of those at one-quarter mile; levels at one mile were about one-eighth of those at one-quarter mile. However, exterior dust lead levels were not correlated with distance from smelter, suggesting that they may be related to spillage from lead ore concentrate trucks that pass through the community.

The available blood lead data and corresponding environmental lead data for Herculaneum do not allow a determination with any certainty of the exact dust lead cleanup level to recommend using only site-specific data. An analysis of the limited amount of blood lead data available did reveal a very strong correlation with distance from the smelter as mentioned in the previous paragraph with house dust lead loading. This suggests house dust is one of the major contributors of lead exposure to children. Floor clean-up levels of less than 24 µg/ft2 determined from the Big River lead mining site (Sterling et al., 1999) in St. Francois, MO, were found to be associated with no more than 5% of the blood lead values above 10 µg/dl. Over 80% of the sites evaluated from the Big River study had soil levels greater than 400 ppm, the soil clean up level presently being used in Herculaneum, and the lead dust is primarily from ore concentrate, also similar to that used in Herculaneum.

Suggested Workplan

Based on the above and similar findings by Lanphear et al. (1998) that the current EPA standard for floors of 40 µg/ ft^2 is not sufficiently protective, a floor lead clean-up goal that is lower than the current EPA standard for floors is recommended. From a scientific basis, and supported by Sterling et al. (1999), a goal of 20 µg/ft2 is recommended. Using the most recent data available, 12 of the 17 houses in Herculaneum have floor dust lead levels of less than 20 µg/ft^2 measured during the last sampling period of each house. With additional interior house dust lead removal, lead-based paint stabilization and repeated exterior lead dust street cleaning, the latter on an expanded area basis, the goal of 20 µg/ft2 appears to be attainable. There is no corresponding literature available for windowsill clean-up goals; however similar reasoning would suggest a goal of 125 µg/ft2. Currently 50% of the houses have windowsill lead levels consistently less than this value at the time of the last sampling period. There is a statistically significant trend for house dust levels to decrease with time, which may be related to long-term impact of soil replacement, street cleaning and cleaning of additional homes.

3. Recommended Site-Specific Interior Cleanup Protocols -

Background

For 15 of the 17 houses for which data has been presented, the special lead dust removal occurred prior to May 2002, the date that major emission control efforts at the Herculaneum smelter were in place. A communication provided to the Focus Group by Doe Run indicated that this premature cleaning might be responsible for some houses not meeting the HUD cleanup goal. We suggest that consideration be given to cleaning these houses again.

For 4 of these 17 houses, at least one dust wipe sample during the last recontamination sampling for that house had a lead level that exceeded either the EPA floor or window sill standard. Three of the 17 houses in the last sampling period exceeded the EPA floor standard. Four houses exceeded the windowsill standard, which included the same 3 houses above. Of the 3 exceeding the floor dust sample, 2 had interior lead-based paint present. These findings suggest that the soil removal and replacement at the house and/or the household cleaning program were generally sufficient to bring dust lead levels below the present EPA health-based standard and to the proposed clean-up level. If houses that were cleaned before completion of the major smelter emission control improvements were put into place are recleaned, as recommended in this report, levels are likely to further decrease. The excedences of current EPA dust lead limits may be due to high levels of lead dust found in street samples, deficiencies in the house cleaning protocol, contamination from neighboring house areas that have not received either soil abatement or house clean up, contamination dust reservoirs in the house (e.g. attic spaces, basements and wall cavities), the presence of LBP, or continued contamination from the smelter operations or some combination of these factors.

The results of the carpet cleaning efforts are similar to those reported in Ewers et al. (1994) and Yiin et al., (2002), where the difficulty in cleaning carpets was demonstrated. These data support the recommendation that consideration be given to replacing some of the carpets. Establishing objective criteria involving actual dust lead measurements of individual carpets would be difficult and expensive. It would involve determining the loading (μg/ft), cleaning the carpet, retesting and determining if the cleanup level was met. If not met, replacement would be warranted. It is likely that the cost of this procedure would be at least as high as the cost of replacement. Review of the literature doesn't provide any explicit information as to when a carpet should be replaced when routine or even extensive cleaning fails to adequately reduce lead loading. In the Ewers, et al. (1994) study naturally soiled carpet was taken from homes and vacuumed at a rate of 1 min/m^2 using high efficiency vacuums. After four cleaning cycles of the carpets (total of 4 min/m^2) the cumulative average amount of lead removed was 74% of total that was removed after a total of 10 min/m^2. Ewers, et al. (1994) found that surface lead loading can actually increase after the first one or two vacuum cycles, however, on average lead loading will usually be reduced after the third cleaning. Lewis, et al. (2002) studied various aspects of lead loading, pile density, and wear on removal of lead-contaminated dust using a dry vacuuming process and typical home vacuum cleaners. Using artificially soiled carpets they found that lower initial lead leading did not affect of lead removal effect on removal from high or low-density carpet. At high loading, however, pile density had a major effect on lead removal with 54% more lead removal from low-density carpets. More importantly, at high levels of loading carpet wear has a significant effect on lead removal, particularly with low-density carpets (or possibly inexpensive carpets). In summary, it appears that many carpets may be able to be cleaned to reduce lead loading below HUD action levels. However it may take a number of thorough cleanings and the carpets may not remain clean if the carpet is heavily contaminated or worn. If carpet wipe dust lead levels do not meet the established goal after thorough cleaning, particularly if the carpet shows visible signs of wear, than it be removed from the house. It is recommended that, where feasible, new carpets not be put back into the housing, since it is easier to clean a solid hard surface more effectively than cleaning carpets. Some floors would have to be treated to fill cracks and other repairs made to make them cleanable and smooth enough for walking directly on them.

The carpets of many of the houses have been sampled using both the HUD wipe method and a HEPA sampling method on side-by-side areas. The HEPA method uses the same equipment as is used in the street and exterior entry dust sample collection. The vacuum method produces a sample that can be tested for both lead concentration (ppm) and lead loading (μg/ft^2) Statistical analysis has shown that the concentration and loading are correlated (r-squared = 0.75, p <0.0001). The vacuum method sample has an average loading value about 150 times that of the wipe method since it is capable of capturing dust from below the carpet surface.

A brief examination of the X-Ray Fluorescence (XRF) paint lead monitoring results from Herculaneum revealed that 8 of the 15 houses for which data were available showed lead-based paint (>= 1.0 mg of lead per square centimeter) on interior and/or exterior surfaces. For the houses where exterior results were not provided, it was not noted whether or not exterior painted surfaces were present or tested. It is important that housing units be examined for lead-based paint using the protocol specified in the HUD Guidelines when elevated blood lead children are present or where dust lead level goals cannot be met. If the Jefferson County Health Department needs additional resources to conduct such an expanded testing program, it would be helpful if such resources were made available. Emergency paint lead stabilization and abatement funds/skills should be made available such as for EBL events or other homes where young children move in and lead dust goal levels have not been achieved.

Suggested Workplan

A. Basic Considerations

Ideally, cleaning should be performed in a manner so that residents can re-occupy the home the same day. In order for this to be accomplished, the analytical method used to determine if the cleanup goals had been met must be capable of providing results soon after dust wipes are collected, preferably within an hour. If floors have to be sealed, an overnight relocation will be required because the sealing material will take some time to dry. Residents should, if possible, not have more than one-overnight relocation. Doe Run and/or the cleanup contractor should be responsible for quickly replacing or fixing any items damaged by the cleanup with items of equal or greater replacement value. Prior to the initiation of any cleanup activity in a home the resident and the contracted cleanup team should meet to review a standard cleanup contract outlining the process and specific responsibilities of those involved. Consideration should be given to documenting pre-cleaning conditions through use of a video camera with the recording to be destroyed after satisfactory completion of the cleaning. Any special circumstances or issues associated with the residence and the scheduled cleanup will be noted and incorporated into the contract at that time. At a minimum, cleanup shall be performed following the protocol set forth in HUD Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing. Sampling of lead levels shall be performed in all locations specified in the protocol and any other areas determined to be needed such as because of use as a living area or otherwise affecting the living area. If a Herculaneum or house-specific interior cleanup plan specifies more stringent or more extensive cleanup measures, the plan shall take precedence over the HUD Guidelines. A brochure should be developed, probably using an existing brochure as a starting point, to assist the residents in performing some special lead dust clean-up operations on their own. If overnight relocation is required, adequate provisions for relocation and lodging should be made.

B. Cleaning Method

The lead dust clean-up protocol in the HUD Guidelines for the Evaluation and Control of Lead

Based Paint Hazards in Housing (HUD, 1995) should be specifically followed. These guidelines specify important details such as the amount of time needed for the cleaning process for both carpets (HUD Chapter 11) and hard surface areas. Cleanup shall also include furniture and play area items. Cleaning should be performed in a manner so that residents can re-occupy the home the same day whenever feasible. Performing a post clean-up test method that provides immediate results is needed to facilitate this happening. Re-cleaning should occur in any room, and similar surfaces in rooms not tested, that exceed the set value for the sampling method used.

4. Recommended Site-Specific Interior Sampling Protocol

A. Pre-Cleaning Monitoring

Sampling for lead in house dust should be performed ***prior*** to all cleaning activities, and should occur no more than seven days prior to cleaning. A modified HUD evaluation protocol should be used which involves the collection of a minimum of seven to nine dust wipe samples taken from a minimum of 4 floors and 3 windows (Galke et al., 1999). Two children's bedrooms should be sampled if there is more than one child under the age of 6 living in the home. Recommended sampling locations include: floor sampling from the interior entry, doorways to the kitchen, youngest child's playroom area (may be living room) and bedroom, and second child's bedroom if present; interior window sills from the child's bedrooms, playroom and kitchen. Additional floor samples must be collected in the attic and/or basement if used as a living or play area, or otherwise accessed frequently.

B. Post Cleaning Evaluation Of Interior Cleaning Performance

Portable x-ray fluorescence analyzers (NITON, Inc.) are capable of providing rapid analysis of dust wipes as soon as they are collected as has been documented by research of the authors of this report. Readings should be taken for 60 nominal seconds as specified by the manufacturer. If results from floor dust wipe samples are at or above a value determined through site-specific developed calibration curves, the level shall assume to be at or above the clean-up level established and cleaning shall be repeated. Evaluation of cleaning should be performed. All testing for lead in house dust following cleaning should occur no sooner than one-hour after, and no later than 24 hours after cleaning is complete. Subsequent testing of cleaning should consist of samples alternating from one side to the other of the doorway or window for the first two times. If additional re-cleaning and testing is needed, samples should be taken from alternate windowsill and floor areas.

If carpet lead dust wipe results are greater than set value, and the carpet is not considered cleanable (i.e. would be damaged, etc.), then resident is eligible for carpet replacement, which includes removal of padding and cleaning of subfloor. Preferable to carpet replacement, as mentioned earlier, is ensuring that the uncarpeted floor is cleanable and otherwise appropriate for residential use. Otherwise, decisions will be based on post cleaning results. Collection of a wipe from an immediately adjacent area from which a carpet vacuum sample had just been collected may provide useful additional information to be used in the decision-making concerning possible carpet replacement. If a carpet test following any cleaning, and particularly re-cleaning, exceeds set point, then resident should be considered for carpet replacement or making the floor cleanable.

An occupant satisfaction survey will be developed and used following the completion of all cleaning activities. The form should be designed to determine the resident satisfaction of the overall process and allow feedback for modification of the process and procedures as needed.

C. Follow-up Monitoring

All homes where cleaning is performed are to be checked on a quarterly basis if resources are available. Sampling will be performed in a similar manner and locations as the pre-cleaning monitoring. If one room exceeds the standard, a cleaning of that room must be offered. If two or more rooms exceed the standard, a cleaning of the entire house must be offered. If levels are found to be greater than or equal to 20 $\mu g/ft^2$ for two follow-up tests, a more thorough inspection for lead re-contamination sources will be performed. This inspection should include lead-based paint; evidence of dust lead seepage from attics, air ducts and walls and outdoor sources. The results of this inspection will form the basis for the development of a site-specific intervention plan, and corrective measures taken. A complete inspection and determination of potential source such as above should also be performed for all elevated blood lead events. In addition, interim control measures shall be performed/provided, such as walk off doormats for entryways to reduce the tracking of dust, sod for bare yard areas, and so on.

Homes cleaned on one or more occasions prior to the adoption of the Revised Interior Cleanup Plan shall be considered part of this plan, and are eligible for home quarterly follow-up based on the same guidelines. These houses should be considered for additional cleaning if dust lead goals have not been achieved. Issues associated with difficulty with obtaining initial and follow-up access into homes for cleaning and monitoring need to be addressed.

5. Other Action Items

A. Additional Sampling (other than interior)

<u>Soil Replacement and Monitoring</u>

Background

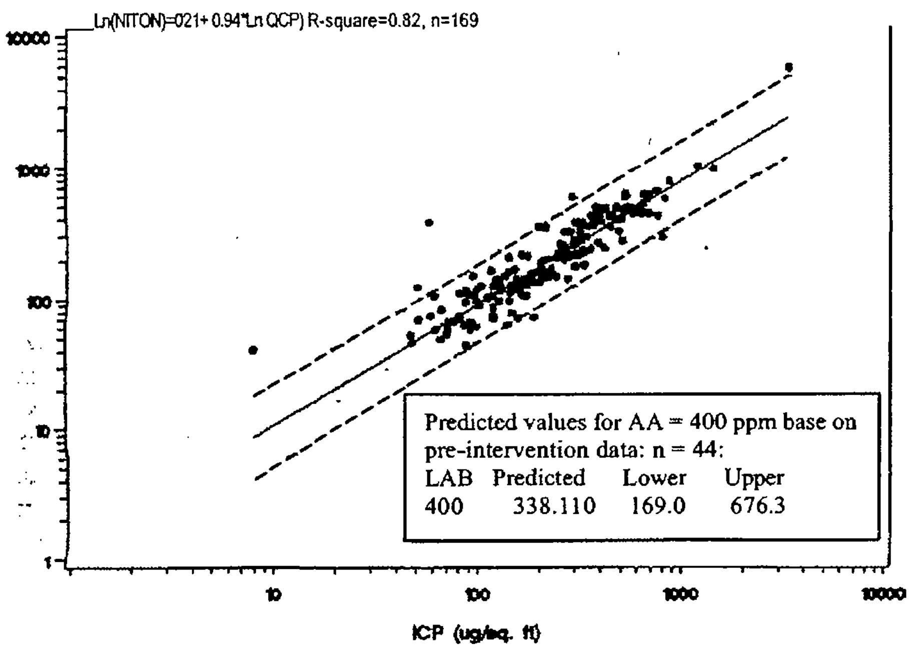
A significant amount of interior dust comes from exterior sources. This connection has already been recognized in the Herculaneum cleanup project, insofar as residents are not eligible for interior cleaning unless they first have their yard soil tested and replaced where necessary. Yard remediation should be done in the most effective manner possible with the least amount of inconvenience to residents. Soil contamination poses two risks: residents can be exposed to lead directly from soil dust while they are outside their own and neighbors yards, and soil dust (containing lead) can contribute to household dust and hence to interior lead exposure. It is important that all residents eligible for soil testing and replacement participate in the program to help reduce potential for recontamination of neighboring areas.

The current US EPA standard of 400 ppm for bare soil in residential areas appears to be appropriate for Herculaneum. Post intervention soil lead measurements in Herculaneum to check for recontamination show an overall mean of 87 ppm. An ATSDR Health Consultation noted one home in Herculaneum that had its soil replaced in 1999 with soil containing 14 ppm lead (ATSDR, 2002), had levels above 400 ppm in testing performed in 2001. This shows that recontamination has occurred. Since replacement soil containing only 14 ppm was apparently available in 1999, we recommend that replacement soils have a lead level less than the current guideline of 100 ppm, provided that the soil also meets agronomic requirements.

Using the soil preparation methods practiced at the time of this data collection the field portable XRF (X-ray fluorescence analyzer) device gave lead measurements that tended to underestimate the soil lead concentrations. For example as demonstrated in Figure 1, using the pre-replacement available data the XRF must give a reading of 170 ppm or less for there to be a 95% certainty that the soil lead concentration (as measured by atomic absorption (AA) analysis) is in fact less than 400 ppm (Clark and Sterling, 2002). It may be useful to investigate other methods of preparing soil samples, such as by a simple sieving process that can be performed in the field, so that the XRF results more closely match those obtained with atomic absorption. Another field portable lead-testing method that could be investigated for possible use is Anodic Stripping Voltammetry (ASV).

Figure 1

Relationship Between Soil Lead Levels Measured by Field Portable XRF and by ICP Method (Pre-intervention)



Predicted values for AA = 400 ppm base on pre-intervention data: n = 44:

LAB	Predicted	Lower	Upper
400	338.110	169.0	676.3

Suggested Workplan

It is important to increase the participation of residents in the soil sampling and replacement program. Use of sod rather than grass seed could increase the percentage of residents who participate in the program. The yard remediation procedure should not take longer than one week; from the time removal of old soil begins until the time the sod has been completely installed. In addition this work should be completed during the workweek (i.e. bare soil should not be left exposed over a weekend). There should be a minimum of six inches of topsoil; the soil should have a low lead content (less than 100 ppm and as close as possible to the national average of 40 ppm). However, the replaced soil/sod must meet the agronomic needs for which it is intended.

Based on a review of the results of the post-intervention soil monitoring protocol, there does not appear to be any evidence that the replaced soil is becoming contaminated during the first year since soil replacement. Since soil recontamination would be initiated with the top layers of soil becoming contaminated from fallout or ground level transport of lead containing particles, the top one-inch soil lead sample would not readily reflect such contamination. Surface scraping samples are a more sensitive indicator of contamination of the replaced soil by lead dust and were instituted by the EPA in Herculaneum during 2003. We did not have the opportunity to review the additional surface soil sampling data and so cannot comment on those results. If a written protocol is not yet prepared, a protocol for a soil-scraping sample is available in the Protocol from the Three City Urban Soil-Lead Abatement Demonstration Project (EPA 1993).

We suggest that quarterly monitoring include a collection of soil surface-scraping samples B.

B. Long-Term Monitoring

Long-term monitoring is important to evaluate the success of any intervention implementation programs, to detect needed modifications/changes, and to help determine the need for continuing corrective actions. This monitoring should be performed at homes that participate in the cleaning program and/or soil replacement program, at selected sentinel homes and at selected street sample locations. Long-term sampling method types should include those for settled dust within homes (wipes and carpet vacuum samples), exterior and interior dust fall, soil scraping and cores, and street and exterior entry dust vacuums. Methods for all sample collections have been previously described here and/or elsewhere.

Dustfall data would provide another way to monitor the impact of emission control measures associated with the smelter and its operations and the neighborhood dust lead removal efforts. Protocols for interior dust fall are available from the Trail, B.C. Task Force and from the US EPA Urban Soil Lead Demonstration Project (EPA/600/AP-93/0010, August 1993). Exterior dust fall measure should be obtained at areas that can be kept secured, such as air monitoring stations and/or by the EPA trailer or school, and that are representative based on distance and typography. We understand that EPA/Tetra Tech are considering and performing a dustfall trial. They should reference and/or discuss the dustfall method that they are developing.

We also recommend two exterior dust vacuum samples being added to the house testing protocol: an exterior entry sample and a street sample. These samples can be collected by the procedure that is currently being used in Herculaneum to collect street dust samples. At the time of the completion of this report, it is our understanding that this additional monitoring had already been added to the Herculaneum sampling protocol.

Table 1: Recommended Long-term Sample Locations, Types and Frequency

	Locations				
Sample Type	Sentinel	Interior Cleaning	Soil Replacement	Streets	Other
Dust Wipe	Quarterly	Quarterly			
Dust Vacuum - Carpet	Quarterly	Quarterly			
Dust Vacuum - exterior entry	Quarterly	Quarterly		Quarterly	
Dust Vacuum - street	Quarterly	Quarterly		Quarterly	
Dust Fall - Interior	Quarterly	Quarterly			

Dust Fall - Exterior					Quarterly - secure location
Soil Sera in -					
Soil Core	Bi-annually		Bi-annually		

C. Trust Fund

It is more cost effective to perform attic and wall cleanup at the same time as home renovations are underway, or as additional lead-based paint hazard reduction measures are performed. Timing is the issue, and if these activities were going to occur after much of the other lead exposure reduction measures were to be implemented, then it would make sense to establish some procedure to make sure funds were still available to support these efforts. The time when ceilings and walls are removed/replaced/repaired also presents good opportunity for considering whether additional insulation is needed for the home. The need for such insulation is independent from the lead issue, but it would be more economical to perform when access to wall space and attics is available. Other activities that might be included in such a fund are:

- Home renovations that will disturb areas not previously sampled and may be contaminated, such as air ducts, wall partitions, attics, ceilings, and basements;
- Further sampling and intervention needed when goals cannot be met - such as house dust levels after two follow-ups, recontamination of yards, and so on;
- Additional investigations and corrective action resulting from EBL events;
- Monitoring and cleaning needed when families are moving into previously untested homes with children;
- Long term relocation during home remediation; and,
- Permanent relocation, such as home buy out. A mechanism/plan is needed to eventually bring these into lead safe housing condition for re-occupancy or to be replaced by new housing.

D. Health Communication -

Background

Implementation of an effective workplan requires that Herculaneum residents believe that the plan is effective, they must trust the individuals that will be implementing the plan, and they must participate in the plan. Such trust cannot be expected unless the residents are provided sufficient information about, and input into, the process. This can be best achieved through some or all of the following educational/communication methods.

Community-specific literature is needed. This information is also needed for painters, remodelers, hardware stores in addition to homeowners and renters. It would also be useful to develop or locate existing education modules that can be used in the public schools at various grades. If there is a vocational school in the area that has home improvement courses, they might be able to disseminate the educational materials.

Educational materials should be prepared for such activities as renovations, attic access and wall interior remediation. The results of the exploration of Doe Run test and other homes could provide site-specific intervention techniques and photos of situations that occur in Herculaneum.

It is necessary to provide for the disclosure to present and future home occupants and owners on existing and potential lead hazards. This is important and is required by law when there is information on lead hazards. This information disclosure also should include real estate agents, financial institutions, etc.

The broad representation of the Task Force can help develop appropriate delivery modes for educational materials. It would be useful to invite others to observe some of the Task Force and other related meeting and/or to hold the Task Force meetings in conjunction with PTO's, and so on. There may be a teacher(s) in the school system that is interested in using some aspect of the Task Force activities as a class project or for extra credit. The State of California produced a 'lead calendar' a couple of years ago which used drawings by school kids to illustrate a number of points- the effects of lead on children, ways lead exposure occurred, ways to reduce lead exposure, etc. There are a number of such examples. Maybe some can be developed here.

A focus group could also explore reasons why soil replacement and special home treatment for lead removal programs do not seem to be acceptable to a number of community members.

E. Task Force

All Herculaneum work plan activities shall have an ongoing evaluation such as by a Community Oversight Board.

Such a board could consist of members from the following groups:

- The Herculaneum Community Advisory Group
- US EPA
- Other agencies (DNR, ATSDR, etc.)
- Doe Run Corporation
- Contractors
- Outside experts

The Board could review comments or complaints made by residents. The Board could report grievances and recommend courses of action to remedy such grievances to the responsible parties.

To aid the Board, residents should be given evaluation forms to complete upon conclusion of any workplan activities. These evaluation forms should be simple to complete and submit to the Board.

On an annual basis all workplan activities shall be evaluated in order to:

- *Assess the effectiveness of the plan.* Measures of effectiveness include community participation rates, level of community satisfaction with the decontamination program, efficiency of the protocol, and attainment of lead contamination goals.
- *Recommend and implement changes to the plan, if* deemed necessary to increase the effectiveness of the cleanup process. The cleanup plan shall maintain its basic structure and function in any revisions, but specifics such as cleanup procedure, lead clearance goal levels, or grievance reporting mechanisms may be modified to better achieve Herculaneum health goals.

6. Other Action Recommendations

A. Impact of Street Dust Lead on the Environment

Background

Since lead in dust is mobile, it can move from site to site within a community. Such movement varies with time and varies between communities depending on the sources and activities occurring. Street dust lead has been found to contribute to the loading at the exterior entry to housing, which then impacts interior dust lead levels. In Herculaneum, spillage of lead concentrate from haulage activities can contribute to high street dust lead levels in some areas. In areas where paint lead is the major source, soil and exterior entry dust lead has been contributing to soil lead. Lead levels in various environmental compartments (street dust, other exterior dust, soil and interior dust) are interrelated. Since the sources of the lead can vary, the pathways among the environmental lead variables can also vary. In the HUD Evaluation (Clark et al., 2003), which involved houses in many areas of the country, it was found that in general lead from housing (exterior dust and soil) affected lead levels on streets. (In Herculaneum the reverse may be true, especially along the haulage routes.) In addition, the HUD evaluation results showed that lead at the exterior entry of the house moved toward the interior portions of the house. A study of samples in Herculaneum from streets, soil and houses concluded that 30% of household dust comes from exterior soil and 50% is from road dust (Johnson and Abraham, 2002). Similar conclusions about the contribution of soil to interior dust were reached in several other studies conducted outside of Herculaneum: One study estimated that 30% of household dust came from soil (Calabrese and Stanek, 1992). Another study found that 37% of household dust came from soil (Sterling et al, 1998). Yet another study estimated that 50% of household dust originated in soil (Forbes et al, 1986). Monitoring all three locations can help in subsequent corrective actions for homes where re-contamination continues to be a problem.

Dust lead levels on Herculaneum streets are the highest reported (Clark and Sterling 2002), probably due in part to the transport of lead concentrate through the streets in Herculaneum. A review of the street cleaning data presented at the September 2002 Focus Group Meeting revealed a considerable overlap in lead dust concentration and loading between primary and secondary lead concentrate haul routes Overall, concentrations and loadings appear to be lower on the secondary haul routes than along primary haul routes. There is, however, a considerable overlap in the ranges of values with maximum values at sampling locations varying from 5900 to 190,000 ppm (mg/Kg) compared to 37,000 to 94,000 for the primary routes. Values at secondary route sampling stations ranged from 1,009 to 34,900 ppm (median 3,700) and 0.72 to 7.22-mg/ft^2 (median 1.34), compared to 8,100 to 40,000 ppm (median 16,000) and 0.77 to 8.72 mg/ft^2 (median 2.38) for the primary route stations. The overlap raises the question of whether other streets in Herculaneum have similarly high levels. Concentrations of lead in street dust in Herculaneum (median of 16,000 ppm and 3,700 ppm on primary and secondary routes, respectively) are much higher than those in Trail where levels were 1123 ppm before the new smelter was built and 888 ppm afterwards. The street dust lead loadings in Trail decreased from 20 mg/ft^2 before the smelter was installed to 11 mg/ ft^2 afterwards. The Trail levels are much higher than those in Herculaneum, median of 2.38 mg/ft^2 and 1.34 mg/ ft^2 on primary and secondary routes, respectively.

Suggested Workplan

To evaluate the relationship between exterior entry dust lead and lead levels in street and house dust, we recommend that the sampling method presently used in Herculaneum to obtain street samples should be employed at all homes being monitored to sample their exterior entry areas and adjacent street dust. Additionally, street dust monitoring locations should be established near the smelter - especially near entries and exits to property (haulage roads, employee and supplier entry roads etc) to help monitor the effectiveness of smelter emissions and haulage spillage reduction activities. Sampling sites on streets that are not primary or secondary haulage routes should also be selected.

The frequency of the monitoring for street dust should be quarter, but with the additional sampling specified here and in later sections following. Depending on the results of this expanded street dust sampling, the need for cleaning these other areas can be assessed. If levels are similar to primary or secondary haulage routes, cleaning should be considered on a similar frequency.

B. Sentinel housing

Houses of representative ages and locations in regards to distance from the smelter and ore haulage routes should be included. It is possible that this has already occurred. It should be possible to find data on the age of the Herculaneum housing stock to make sure that the houses sampled are representative of the housing in the community.

C. Test housing/Attics/Walls

Attics are usually very dusty. Since attics are usually designed to have ventilation that is adequate to prevent moisture build-up, there are openings to the outside air. These openings have allowed air contaminants to enter the house over the years and the particles to settle. Sealing the attics would have to be performed in a manner that would preserve the ventilation characteristics while at the same time trying to minimize entry into the living space. Provided the ceilings are intact, most of the attic contaminating that enters the living space probably comes through the access to the attic (trap doors, pull-down stairs, regular stairs etc). It would first have to be determined the type of access to the attics and the use of the attics. This can range from very limited through a trap door of some type to fully finished attics. It is likely that many of the homes have the former type. If that were the case it probably would be more effective to prepare a better trap door, taking care to prevent house contamination during the process. If the ceilings below the attics are in poor condition and contain lead-based paint, then replacement may be warranted since patching plaster is expensive. To obtain a smooth finish, moreover, it is usually more economical to replace the plaster ceiling with drywall. If that were done, it would make sense to clean the attic at the same time since the dust would be disturbed in the process. The basic cleanup effort needed for this task, would amount to a major portion of the attic clean up.

In order to explore the level of lead contamination in attics and within wall, and the impact of attic fan use, it would be useful to explore contamination levels and useful remediation techniques in some vacant houses that have been purchased by Herculaneum. Various approaches could be taken to clean attics, ductwork and walls; the extent of lead contamination in these areas could be determined and the extent to which these locations of lead dust contaminate the living space could be explored. As long as attics are not part of the living space, site-specific clean-up levels would not need to be achieved, only a significant reduction in available lead dust and a reduction of its impact on living areas.

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Region 7

Iowa
Kansas
Missouri
Nebraska

Fact Sheet

September 2006

Herculaneum Lead Smelter Site
Herculaneum, Missouri

COMMUNITY ADVISORY GROUP MESSAGE

The following section was submitted by the CAG Core Team.

The Community Advisory Group (CAG) remains committed to a Better Herculaneum. We believe that the most productive approach to the pursuance of a better Herculaneum is a two-step program that needs to be implemented simultaneously. The two components are:

1. An open approach pursuing possibilities for an enhanced future such as new business possibilities, new uses of the property within and outside of the Voluntary Buy Out Area, etc.

2. A realistic and factual view of the current and future status of the health climate within Herculaneum and the surrounding area is important to being aware of the current condition of our city. More specifically, what is the current situation within Herculaneum relative to levels of lead and other health threatening metals resulting from emissions and other contamination sources such as spillage from delivery trucks? Many of these sources are demonstrably due to various activities conducted by the Doe Run Primary Smelter.

Community Advisory Group Meeting

The next meeting of the Herculaneum Lead Smelter Community Advisory Group will be held:

Tuesday, September 19, 2006
7:00 p.m. to 8:30 p.m.
Herculaneum High School Cafeteria
Herculaneum, Missouri

Before the next CAG meeting with the U.S. Environmental Protection Agency, the Missouri Department of Natural Resources and the Missouri Department of Health and Senior Services on Tuesday, September 19, 2006, we would like to provide the readers with some facts that continue to apply to our city. We also want to provide you with a preview of some of the specific questions that we have asked the agencies to respond to during the above meeting.

The Core Team, which conducts the meeting, has asserted that they will continue their record of the last two

Dissemnated Information

meetings, which is starting the meeting at 7 p.m. and ending it at or before 9 p.m.

The CAG would like to acknowledge Doe Run for meeting the National Ambient Air Quality Standards (NAAQS) for lead on all of the air monitors for the second quarter of 2006. However, these NAAQS standards, which were established in 1978, are currently under review by the Environmental Protection Agency.

Fact #1: Doe Run has been described as the largest polluter in the area in the St. Louis Post Dispatch article on May 14, 2006--"Locally, the largest waste producer in overall weight for that year (2004) was the Doe Run Co.'s Herculaneum lead smelter, followed by U.S. Steel Corp's plant in Granite City and Ameren UE's coal-fired power plants. The Doe Run facility generated more than 10 million pounds combined of zinc compounds, aluminum dust, lead and other metals that are disposed of on site."

Fact #2: The Speciation and Bioaccessibility of Anomalous Lead Concentrations in Soils from the Herculaneum Community, May 24, 2005, concluded that, "neither paint nor gasoline are significant lead contributors to the site (Herculaneum)". This emphasizes that the lead contamination of the community is not from paint nor gasoline but mainly from the Doe Run Smelter.

Fact #3: Recontamination of Herculaneum, after yard clean up, house interior clean up, road clean up and stated efforts to control emissions from the Doe Run Smelter, has been and continues to occur. This fact is based on the ongoing data collection conducted by the EPA.

Fact #4: The important work involving the EPA and DNR and their efforts to maintain a healthy climate in Herculaneum began in 2001 and continues.

In spite of these facts, we remain upbeat about the future of Herculaneum and believe that a healthy physical climate is an essential component of Herculaneum's bright future.

The following topics have been sent to both the U.S. Environmental Protection Agency and Missouri's Department of Natural Resources. We have asked the agency representatives to come prepared to address these and other topics. Please come and hear these and other questions that you have, addressed by agency representatives. We also plan to ask a Herculaneum representative to come and give residents a status report on the project to replace the city's bridge.

CAG Meeting Topics

- ▶The Doe Run fence move
- ▶The progress on developing the State Implementation Plan (SIP)
- ▶Road contamination
- ▶Activity by E-squared
- ▶Recontamination
- ▶Total cost of clean up of Herculaneum (to August of 2006)
- ▶How much has Doe Run been billed for and how much has Doe Run paid?
- ▶Progress on construction of the existing bridge

Again the Core Team is committed to completing the formal part of the meeting by 9 p.m. or earlier. We look forward to seeing you and hearing from you.

CAG Group Core Team Members

Catherine Malugen
Tim Meyers
Larry O'Leary

SLAG PILE UPDATE

On July 24, 2006, EPA and the Missouri Department of Natural Resources reached an agreement with The Doe Run Resources Corporation to modify the Administrative Order on Consent for the Herculaneum Site. The modification requires Doe Run to implement a removal action for the slag storage area, providing for stabilization, erosion control, flood protection, stormwater collection and treatment, and wetland mitigation.

NEW JOACHIM BRIDGE

In July, a U.S. Senate subcommittee allocated over $2.5 million to be used to build a new bridge over Joachim Creek near the southern end of Herculaneum. This allocation is part of a larger spending bill and must be approved by the full Senate and later reconciled with a House of Representatives' appropriation bill. The new bridge will be less prone to flooding and will provide for commercial truck and vehicle access to and from the industrial facilities through non-residential areas of the city.

Rebuilding of the existing closed bridge over Joachim Creek is scheduled to begin this October with a planned completion date in April 2007. Doe Run reports that the old truck route along Station and Brown Street will be used for their trucks once the rebuild is completed.

BIANNUAL MONITORING

Monitoring for lead recontamination in surface soils is being conducted by EPA every six months. The data collected through May 2006 indicate that lead levels are trending upward in areas within eight-tenths of a mile from the smelter. Data and statistics collected by EPA are available on EPA website: www.epa.gov/region7/cleanup/superfund/major superfund site reports.html

ADDITIONAL INFORMATION

EPA encourages the community to review the Administrative Record file, which is available at the following locations:

Herculaneum City Hall
1 Parkwood Court
Herculaneum, Missouri

Windsor Branch
Jefferson County Library
7479 Metropolitan Boulevard
Barnhart, Missouri

EPA Region 7
901 N. 5th Street
Kansas City, Kansas

If you have questions or need additional information, please contact:

Dianna Whitaker
Community Involvement Coordinator
EPA Region 7
901 North 5th Street
Kansas City, Kansas 66101
913-551-7003, Toll-free 1-800-223-0425
E-mail: whitaker.dianna@epa.gov

TAB 4

Metropolitan Newsclips Service
P.O. Box 3195 • St. Louis, MO 63130

St. Louis Post-Dispatch/Illinois Edition
St. Louis City County
St. Louis MO

33044 Weekly
57810 Sunday

July 21, 2006

Neighbors hope Doe Run revitalizes land

113 234 403

What will happen in the 135-acre area once the buyouts are complete? Land-use committee and public meetings produced some ideas.

By Benjamin Poston
ST. LOUIS POST-DISPATCH

HERCULANEUM • When it comes to the buyout zone surrounding the large lead smelter, residents here say they would like to see the land revitalized.

City officials want to redevelop the area within three-eighths of a mile of the lead smelter owned by Doe Run Co., which has acquired 140 of 169 houses in that zone through a voluntary buyout negotiated in 2002 by the Missouri Department of Natural Resources.

But Mayor Gina Vinyard said she had received no indication that Doe Roe intended to revamp the 135-acre area. In Vinyard's estimation, the company wants to acquire all properties in the buyout area so it won't have to address recontamination issues there in the future.

"I can't blame them because they are running their business well, but when you drive by there now, it's a ghost town; it's sad," Vinyard said.

E-Squared, a consulting firm hired by the U.S. Environmental Protection Agency to develop a plan for the buyout zone, organized three land-use committee meetings this year and one public meeting in late June, said Kerry Herndon, a Superfund land revitalization coordinator for the EPA.

Ideas for revitalizing the zone include a commercial port east of the smelter, a casino and a blend of light industrial and commercial businesses, city administrator Bill Whitmer said.

"We need to find a plan that benefits both the city and Doe Run," Whitmer said.

Doe Run has proposed a buffer zone to extend its fence line to the west to allow the company to comply with less stringent federal air-quality standards on its own property, said John Rustige, an environmental engineer with the state's air-pollution-control program.

The state agency's responsibility is to monitor ambient air, defined as air in a space where people have access. The state's Broad Street air monitor is positioned closest to the smelter and typically records the highest pollution levels. By erecting a fence, Doe Run could eliminate the Broad Street air monitor.

"If (Doe Run's) footprint swallows that monitor, then that area is no longer in the ambient air zone," Rustige said.

The fence line is one part of a state plan to be completed next April. Doe Run will have one year to implement the recommendations of the plan, which is intended to make sure the company tests below the federal air-quality standard of 1½ micrograms of lead for each cubic meter of air.

Herndon said Doe Run, budgeted to produce 176,000 tons of lead this year, is in a waiting game on redeveloping the buyout zone until the implementation plan is submitted.

"(Doe Run) can figure out where the fence line will be and then develop the area outside the fence line; it doesn't even take up half the buyout area," Herndon said.

Gary Hughes, general manager of Doe Run, said it's premature to discuss what will become of the land in the buyout zone until the implementation plan is in effect and executed in the next two years.

"We have to see how successful we are in that process; that is our key," Hughes said. "The best use (of the buyout zone) may be as a green field site, but I would never rule out further development of that land. We want to be a good neighbor and protect the public health first and foremost."

Bruce Morrison, the Herculaneum lead cleanup project manager for the EPA, said his agency continued to monitor yard soils for recontamination within four-fifths of a mile from the smelter, a process that began in 2002. The U.S. EPA recently has detected eight samples within one-half mile of the smelter that contained lead contamination exceeding the acceptable federal level of 400 parts per million.

TAB 5

News & Events

Information
for Citizens
for Businesses
for Government & Tribal Nations

Education Resources

Employment

Environmental Topics

Fact Sheet

February 2006

Quarterly Update for Herculaneum Lead Smelter Site, Herculaneum, Missouri

QUARTERLY UPDATES

This is the second quarterly update issued by the EPA Region 7 in our effort to keep the Herculaneum community informed about progress at the Herculaneum Lead Smelter Site. This newsletter includes information about the work conducted by the EPA, the Missouri Department of Natural Resources (MDNR), and the Missouri Department of Health and Senior Services (MDHSS). The Herculaneum Community Advisory Group (CAG) may also use the newsletter to provide community members with information about their activities.

NATIONAL AMBIENT AIR QUALITY STANDARD

On December 19, 2005, EPA published a notice in the Federal Register to invite the public to review and comment on a proposed finding that the Missouri State Implementation Plan (SIP) for lead is substantially inadequate to attain the National Ambient Air Quality Standard (NAAQS) in Herculaneum. Doe Run-Herculaneum violated the NAAQS for lead in three consecutive calendar quarters of 2005. The company and the MDNR operate monitors at the Broad Street monitoring location.

Community Advisory Group Meeting

The next meeting of the Herculaneum Lead Smelter Community Advisory Group will be held:

Tuesday, March 21, 2006
7:00 p.m. - 8:30 p.m.
Herculaneum High School Cafeteria
Herculaneum, Missouri

The standard for lead is set at a level of 1.5 micrograms of lead per cubic meter of air, averaged over a calendar quarter. Doe Run's monitor recorded a quarterly value of 1.928 micrograms per cubic meter in the first calendar quarter of 2005, and MDNR's monitor recorded a quarterly value of 1.877. Doe Run's monitor recorded a value of 1.615 in the second quarter, and MDNR's monitor recorded a value of 1.60 in the third quarter. Air monitoring results at the Doe Run Herculaneum facility fell within the NAAQS during the fourth quarter of 2005.

The deadline for submitting comments on EPA's proposed actions related to the State Implementation Plan for the Doe Run facility in Herculaneum ended January 18. EPA is currently reviewing comments received from the public. For additional information on this action, contact Amy Algoe-Eakin, Air Planning and Development Branch, or Kim Olson, Office of External Programs, 913-551-7003 or toll free 800-223-0425.

YARD SOIL PROGRESS

EPA will continue oversight of Doe Run's replacement of contaminated yard soils during calendar year 2006. To date, 407 yards have been replaced and 113 home interiors have been cleaned.

MONITORING FOR RECONTAMINATION

EPA monitors for lead recontamination in surface soils every six months. The data indicate that lead levels are trending upward in areas within eight-tenths of a mile from the smelter. Data and statistics collected by EPA are available at: www.epa.gov/region7/cleanup/superfund/major_superfund_site_reports.html.

EPA has analyzed soil samples collected through the third quarter of 2005. These samples indicate:

- 45 of 62 quadrants, or 73 percent, show an increasing trend in soil lead concentrations;

- 15 of 16 residences have at least 1 quadrant with an increasing trend of lead contamination.

SLAG PILE UPDATE

EPA continues to negotiate with Doe Run related to the slag pile design, construction and wetland mitigation required by the Engineering Evaluation/Cost Analysis (EE/CA) for the Herculaneum Slag Storage Area. Copies of the approved EE/CA, all comments and related responses are available at the Herculaneum City Hall and the Windsor Branch of the Jefferson County Library.

LEAD SPECIATION STUDY

In September 2004, EPA requested that the Laboratory for Environmental and Geological Studies at the University of Colorado conduct a study to characterize soils and household dust collected from selected Herculaneum residences. EPA has approved the final study report. The CAG requested that EPA include the following verbatim summary from the conclusions identified in the study in our next Herculaneum update.

"Based on data presented in this summary the following conclusions can be reached with respect to the occurrences of lead found in residential soils and dusts from the Herculaneum area.

- Soils have elevated RBA values with respect to the IEUBK default values and are consistent with the elevated blood leads observed at the site.

- Yards and house dust have "fingerprinting" forms, many of these are common to the Doe Run facility.

- Neither paint nor gasoline are significant lead contributors to the site.

Based on the data reviewed in this summary it is my opinion that the lead in residential soils and house dust from the Herculaneum area are the result of activities associated with the Doe Run operation and include; smelter-stack emissions, fugitive emissions from hauling and storage as well as waste and concentration spillages." A copy of the speciation report is available for viewing with other site documents at the Herculaneum City Hall.

VOLUNTARY PROPERTY PURCHASE PROGRAM

As of December 31, 2005, 133 property purchases have been closed and 142 purchase offers have been accepted by Herculaneum residents. Twenty permanent residences did not participate in the Voluntary Property Purchase Program.

ADDITIONAL INFORMATION

EPA encourages the community to review the Administrative Record file, which is available at the following locations:

Herculaneum City Hall
1 Parkwood Court
Herculaneum, Missouri

EPA Region 7
901 N. 5th Street
Kansas City, Kansas

If you have questions or need additional information, please contact:

Dianna Whitaker
Office of External Programs
U.S. EPA Region 7
901 N. 5th Street
Kansas City, KS 66101
whitaker.dianna@epa.gov
Phone: 913-551-7003 or
Toll Free: 1-800-223-0425

TAB 6

STATE OF MISSOURI
Matt Blunt, Governor • Doyle Childers, Director
DEPARTMENT OF NATURAL RESOURCES
www.dnr.mo.gov

DEC 29 2005

Mr. Daniel Vornberg
Vice President Environmental Affairs
The Doe Run Company
1801 Park 270 Drive, Suite 300
St. Louis, MO 63146

Dear Mr. Vornberg:

I am writing to discuss several interrelated issues regarding The Doe Run Company's Herculaneum primary lead smelter and the Herculaneum Voluntary Property Purchase Plan (VPPP) area. These issues include soil recontamination; high levels of interior and exterior residential dust contamination; the disposition of Doe Run-owned and other residences in the Herculaneum VPPP area; a designated non-residential area between the smelter and residential areas; soil action levels; additional controls on smelter, transportation and materials handling, and other processes to prevent releases; and possible future re-development of the Herculaneum VPPP area. Now that the purchase phase of the Herculaneum VPPP is nearing completion, we need to work together on a clear path forward resulting in a sustainable outcome for the Herculaneum community and Doe Run that is protective of public health and the environment. Based on our analyses of soil recontamination data, DNR believes that non-residential uses of the entire Herculaneum VPPP area is the most prudent path forward.

The Department of Natural Resources (DNR) believes Doe Run's substantive responses to actions taken by the DNR and the U.S. Environmental Protection Agency (EPA) have resulted in improved conditions in Herculaneum. However, we believe the weight of the current evidence, including but not limited to air monitoring data approaching and recently exceeding the National Ambient Air Quality Standard (NAAQS) for lead; upward trends in soil recontamination data; elevated levels of lead in residential dust; continued elevated lead levels in road dust; the EPA's speciation and bioavailability data; and agency observations of company operations indicates that challenges and opportunities remain to be addressed. As we move forward, we may need to discuss formalizing remaining current and future actions in a new settlement agreement, administrative order on consent, or other enforceable mechanism.

RECONTAMINATION

In January 2005, the DNR completed its report entitled "Analysis of Lead Recontamination and Deposition in Soils Adjacent to The Doe Run Company's Herculaneum Smelter, Herculaneum, Missouri." This report documented the DNR's statistical analysis of lead re-deposition data from periodic soil sampling and analysis conducted in Herculaneum by the EPA. Since the report was completed, the DNR has periodically updated and refined its analysis of the EPA's re-deposition

Recycled Paper

data upon receipt of new data. These statistical analyses of the re-deposition data indicate significant residential soil recontamination is occurring within 0.75 mile of Doe Run's Herculaneum smelter. Our analyses indicate residential soils within the Herculaneum VPPP area and areas beyond will be recontaminated to unacceptable levels within relatively short periods of time. Soil recontamination at these rates is an unacceptable and unsustainable long-term outcome for the Herculaneum community.

The re-deposition data is sufficient for us to make conclusions about re-contamination rates and areas of impact. However, soil re-deposition sampling and analyses will be needed for the foreseeable future due to potential changes in conditions leading to lead deposition and possible spatial variations in the rates of re-deposition. The DNR will continue to update its statistical analysis of the re-deposition data as new data becomes available, and we will monitor the need for response actions if and when recontamination causes action levels to be exceeded.

We are concerned about interior and exterior residential dust contamination. Based on monitoring data, home interior dust cleanings appear to be generally effective. However, clear trends in residential dust re-contamination are difficult to discern due to inconsistencies in data collection, including the changing universe of monitoring locations. Some interior and exterior residential dust levels are elevated above levels of concern, and re-contamination is possible.

DOE RUN-OWNED HOMES IN THE HERCULANEUM VPPP AREA

The DNR believes the re-deposition study is now sufficiently complete for purposes of making decisions regarding the Herculaneum VPPP area according to the April 2002 Settlement Agreement between Doe Run, the DNR, and the Attorney General's Office (AGO). Paragraph 22 of the April 2002 Settlement Agreement states in pertinent part:

> "Following the purchase of a home, Doe Run shall leave the residence vacant until such time as either Doe Run demolishes the residence or the re-deposition studies, which will use monitoring that begins after June 1, 2002, are complete and the Department of Health and Senior Services, the DNR, the City [of Herculaneum] and Doe Run agree re-occupancy of a residence is not a risk to human health."

Based on our soil re-deposition data analyses, the DNR does not agree that general re-occupancy of residences in the Herculaneum VPPP area is protective of human health in the long-term without continued response actions. On the contrary, the DNR believes continued releases of lead from smelter, transportation and materials handling, and possibly other processes; the lead load in the area from past smelter operations and practices; and recontamination of residential soil and interior and exterior dust may pose long-term risks to human health. The EPA has conducted bioavailability and speciation analyses of samples of materials collected from the smelter facility and the Herculaneum community. The results of these analyses indicate the sources of lead contamination are mostly related to smelter processes, and the bioavailabilities of many of these materials are high.

Doe Run must proceed with demolishing all homes within the Herculaneum VPPP area pursuant to paragraph 22 of the Settlement Agreement. The demolition of homes must be conducted in compliance with all applicable federal, state, and local laws, regulations, and ordinances, and with all necessary permits and notifications. This includes all necessary environmental permits and other applicable requirements, such as proper management of asbestos containing materials and demolition wastes.

Doe Run had previously requested the DNR approve re-occupancy of Doe Run-owned homes in the Herculaneum VPPP area by Doe Run employees. During a meeting on September 8, 2005, between the DNR and Doe Run representatives at the Herculaneum facility, you stated the company was withdrawing its requests for employee re-occupancy of Doe Run-owned homes in the Herculaneum VPPP area. The DNR believes this is a prudent decision by the company and would discourage any future requests for re-occupancy of homes in the Herculaneum VPPP area by people from outside the VPPP area. Doe Run must proceed with demolishing homes in the Herculaneum VPPP area according to the Settlement Agreement, and consider working toward non-residential redevelopment of the Herculaneum VPPP area that is protective of public health and the environment.

DESIGNATED NONRESIDENTIAL AREA

Unfortunately, it appears soil and possibly interior and exterior residential dust recontamination has not been effectively prevented by additional controls on smelter air emissions and improved transportation and materials handling. "It is the DNR's goal to have a healthy environment for Herculaneum citizens while allowing Doe Run to operate in the cleanest manner achievable. The weight of evidence suggests these goals may be mutually exclusive unless a substantial "buffer zone" can be established between the plant and the surrounding community. Doe Run and DNR representatives have discussed establishing a non-residential area between the Herculaneum smelter and residential areas of Herculaneum, although to date there has been no agreement on the size of such a permanent non-residential area.

Doe Run's original proposed area within the Herculaneum VPPP area to be vacated was incorporated into the Second Modification of the May 2001 Administrative Order on Consent (AOC). Doe Run agreed in paragraph 13 of the Second Modification of the AOC that with respect to residences it owns in this area, once the properties became vacant, they would not ever be used for residential purposes. Doe Run has recently proposed expanding the area to be vacated to include additional residential properties and properties owned by the city of Herculaneum, and has developed a schedule for demolishing the houses in this area. However, Doe Run would have to acquire properties from current residents it did not acquire through the

Settlement Agreement and Herculaneum VPPP, including the city-owned properties in order to completely vacate this area.

Doe Run has proposed offering the remaining residents in its current proposed area to be vacated the opportunity to move to other Doe Run-owned homes on the outskirts of the Herculaneum VPPP area, if the residents agree. The DNR is willing to consider this on a case-by-case basis depending on the potential for health concerns. Additionally, before the department will approve such a relocation, the property to be reoccupied must receive necessary and appropriate yard soil replacement, home interior and exterior cleaning, and lead-based paint remediation according to current approved procedures. Periodic soil and home interior and exterior dust re-contamination monitoring should also be conducted for these homes, including pre-cleanup and post-cleanup baseline sampling and analyses. The DNR will need to consider whether it must grant formal exceptions to residency prohibitions according to the Settlement Agreement in these cases.

DNR staff have surveyed the locations of additional ambient air monitors with you, and the Air Pollution Control Program (APCP) is considering Doe Run's proposal to relocate monitors and revise the ambient air monitoring network. Doe Run must submit a revised air monitoring plan for review and approval by the APCP before the new monitoring network can officially be activated.

In general, the DNR's starting point for any permanent non-residential area between the smelter and residential areas is the full extent of the Herculaneum VPPP area. The re-deposition data indicate that significant soil recontamination is occurring out to at least 0.75 mile from the facility, which indicates the Herculaneum VPPP area is not an overly conservative permanent non-residential area around the smelter facility. To the contrary, it is apparent that additional control measures at the facility and/or additional periodic yard and dust remediation will be necessary for remaining homes within the VPPP area and out to 0.75 miles away from the smelter. Unless Doe Run takes drastic and measurable steps that significantly reduces emissions leading to residential yard and road recontamination, the DNR considers the entire Herculaneum VPPP area to be the current designated non-residential area. The ultimate goal is to eventually completely vacate the Herculaneum VPPP area and demolish all of the homes. Toward that goal, Doe Run must submit to the DNR a schedule for demolishing the remaining homes it owns in the Herculaneum VPPP area. The department encourages Doe Run to look for opportunities for commercial/ industrial, and/or other appropriate non-residential re-use of these properties that are protective of human health.

CONTROLS ON RELEASES FROM SMELTER AIR EMISSIONS, TRANSPORTATION AND MATERIALS HANDLING, AND OTHER PROCESSES

At the September 8, 2005, meeting at the Herculaneum facility, DNR staff were encouraged by Doe Run's presentation of several proposed new controls to reduce air emissions in response to violations of the lead NAAQS during the first and second quarters of 2005. Subsequent to the

September meeting, Doe Run Herculaneum recorded its third consecutive calendar quarter violation for the July-August-September quarter. It is imperative that Doe Run reduce its lead air emissions to levels that are consistently in compliance with the NAAQS, and which minimize to the extent possible the contribution of air emissions to soil and residential dust contamination and recontamination in Herculaneum. We look forward to receiving and evaluating more detailed documentation of Doe Run's proposed new air emissions controls.

Doe Run has explained to DNR staff that high levels of lead in air monitoring data on some days may be attributable to atmospheric and wind conditions causing releases of road dust and other fugitive dust from the Herculaneum smelter facility. This information and road dust data indicating continued track-out of lead from the facility demonstrates the need for improvements in on-site transportation and materials handling to prevent releases.

At the September 8, 2005, meeting, Doe Run presented a verbal update of the activities of its Best Practices Concentrate Transportation Team. The DNR is concerned that there have been delays in completion of the written report by Doe Run's consultant, which was originally projected to be completed by July 31, 2005. The DNR has waited several months in anticipation of the results of this project and new actions by the company to control releases from transportation and materials handling. The current schedule for completion of this work is unclear. It also remains unclear whether and how the consultant's report will result in revisions to the Transportation and Materials Handling Plan (TMHP) that will in turn prevent, contain, and reduce the effects of releases from transportation and materials handling processes throughout the network of facilities owned and operated by Doe Run and other entities and along all transportation routes.

The DNR has provided extensive comments on the TMHP and related issues, most recently in letters dated November 16, 2004, and June 7, 2005, to which Doe Run has not provided substantive written responses, or a revised TMHP, as requested. The AGO has also exchanged letters with Doe Run on these issues and asserting the state's authority to enforce the TMHP under the Settlement Agreement. Based on the recent verbal updates provided by Doe Run, the DNR remains concerned and disappointed that Doe Run's current efforts address only transportation and handling of concentrates. We continue to believe all on-site handling and on-site and off-site transportation of concentrates and other metal-bearing materials at all facilities and over public roads and other transportation modes must be addressed on a company-wide basis through comprehensive planning, procedures, and management, and improved facilities. We are also concerned that the current efforts as presented by Doe Run entail what have been described as changes. While there is much to be gained from such logistical changes in terms of preventing and containing releases, we continue to believe that significant improvements may be needed at Doe Run's physical facilities, facilities owned and operated by other entities and used by Doe Run, and transport vehicles to significantly reduce releases from transportation and materials handling. We hope that Doe Run recognizes the economic value of preserving its raw materials and products by preventing releases, and the resulting reductions in environmental liability costs. The related haul route and road dust contamination issues discussed in our previous letters also have not yet been fully addressed. To assist us in evaluating your efforts, we request that you submit a copy of your consultant's complete report when it becomes available, and a revised TMHP, or a schedule for submittal of a revised TMHP incorporating all new controls implemented by the company.

Recent events and observations in addition to those cited by the DNR in past correspondence further illustrate and emphasize the need for comprehensive, company and system wide transportation and materials handling planning and procedures. The agencies have received complaints indicating that Doe Run does not use dedicated transport vehicles for transportation of concentrates and other metal-bearing materials, and that such vehicles are not thoroughly washed before they transport clean materials such as sand, gravel, and soil. This may result in the clean materials being contaminated by residual metal-bearing materials remaining in the trucks. The DNR is currently investigating an instance in which sand was apparently delivered to a ready-mix concrete facility in one or more trucks that had apparently been used to transport lead concentrate. The trucks apparently retained concentrate that contaminated the sand. Some of the concentrate-contaminated sand was delivered to at least one residence for use in a child play area and as base material for an aboveground swimming pool. Agency representatives have observed transportation of crushed lead ore over public roads from Doe Run's mines to the concentrating mills in open top tandem dump trucks without controls to prevent fugitive releases. Doe Run is a participant in cleaning up residential soil along haul routes in southeast Missouri related to releases of concentrates during transportation. The agencies continue to observe releases of fugitive lead from trucks transporting concentrate from the mills to the Herculaneum smelter and other destinations. Observations at the mill facilities and observations and road dust sample analytical data from Herculaneum indicate that metal-bearing materials continue to be tracked out of Doe Run's facilities by transport vehicles. Releases of concentrate into the harbor and on land at the Southeast Missouri Regional Port Authority continue to be documented. Releases have been documented by the agencies at locations away from the mining facilities such as truck drivers' homes and transport company facilities. We have observed concentrate trucks on many different roads, indicating the use of many different routes between destinations along which contamination may occur. Numerous spills of concentrate from truck accidents have been documented, and many of those we are most familiar with have not been adequately cleaned up. It is our understanding Doe Run transports other metal concentrates and metal bearing materials by truck, rail, and barge to other facilities. The transfer and receiving facilities likely have inadequate controls to prevent and contain releases during transport, transfer, and/or storage. We believe it is abundantly clear that changes need to be made in Doe Run's transportation and materials handling plans and procedures on a company-wide and system-wide basis to prevent releases that may cause new contaminated sites, or which re-contaminate sites where cleanups have already been conducted.

FUTURE RE-DEVELOPMENT OF THE HERCULANEUM VPPP AREA

In addition to our primary concerns regarding the health and well being of Herculaneum residents, the DNR is concerned about the effects of abandoning the VPPP area. In general, the DNR would be supportive of non-residential redevelopment of the Herculaneum VPPP area in a manner that is protective of public health and the environment. The new road and bridge projects should improve access to the Herculaneum VPPP area, which should in turn make this area attractive for non-residential redevelopment. The EPA has resources available to assist in developing non-residential reuse prospects for the Herculaneum VPPP area.

Obviously Doe Run's active participation is essential to any efforts to redevelop the Herculaneum VPPP area, since the company will own the majority of the land. We believe Doe Run's participation in such efforts will benefit the company and the Herculaneum community by promoting economic growth in the "old town" area. Such efforts by the company would be consistent with the contributions of Doe Run and its corporate predecessors to the development and growth of Herculaneum, and would help assure an overall positive legacy for the company in Herculaneum.

The DNR hopes that this letter will serve to open discussions with Doe Run and the other stakeholders, including the city of Herculaneum and interested residents regarding the future of the Herculaneum VPPP area, and the possibilities for viable non-residential reuse of this area.

If you have any questions, you may contact me at the Department of Natural Resources, Hazardous Waste Program, P.O. Box 176, Jefferson City, MO 65102-0176, or by telephone at (573) 751-2747, or Mr. Robert Hinkson of my staff at (573) 751-4187.

Sincerely,

HAZARDOUS WASTE PROGRAM

Robert Geller

Robert Geller
Director

RG:rhl

c: Mr. Jeff Kendall, Mayor, City of Herculaneum
Mr. Aaron Miller, Doe Run
Ms. Cecilia Tapia, U. S. Environmental Protection Agency
Mr. Joe Bindbeutel, Missouri Attorney General's Office
Mr. Larry O'Leary, Herculaneum Community Advisory Group
Mr. Gale Carlson, Bureau Chief, Missouri Department of Health and Senior Services

TAB 7

Matt Blunt, Governor • Doyle Childers, Director

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

www.dnr.mo.gov

DEC 23 2005

Mr. Jeffrey Zelms
President and Chief Executive Officer
The Doe Run Company
1801 Park 270 Drive, Suite 300
St. Louis, MO 63146

Dear Mr. Zelms:

I am writing to discuss the disposition of Doe Run-owned and other residences in the Herculaneum Voluntary Property Purchase Plan (VPPP) area. Now that the purchase phase of the Herculaneum VPPP is nearing completion, we need to work together on a clear path forward resulting in a sustainable outcome for the Herculaneum community and Doe Run that is protective of public health and the environment. The Department of Natural Resources (DNR) believes Doe Run's substantive efforts to comply with our various agreements have resulted in improved conditions in Herculaneum. However, much work remains to insure that the area near the smelter does not return to its former highly contaminated condition.

Doe Run had previously requested the DNR approve re-occupancy of Doe Run-owned homes in the Herculaneum VPPP area by Doe Run employees. The DNR sent a letter, dated June 22, 2005, stating that we would consider such a request given prescribed conditions are met by the company and its employees that would re-occupy these homes. During a meeting on September 8, 2005, between department and Doe Run representatives at the Herculaneum facility, Mr. Dan Vornberg of Doe Run stated the company was withdrawing its requests for employee re-occupancy of Doe Run-owned homes in the Herculaneum VPPP area. The DNR believes this is a prudent decision by the company and would discourage any future requests for re-occupancy of homes in the Herculaneum VPPP area by people from outside the VPPP area.

In January 2005, the DNR completed its report entitled "Analysis of Lead Re-contamination and Deposition in Soils Adjacent to The Doe Run Company's Herculaneum Smelter, Herculaneum, Missouri." This report documented the department's statistical analysis of lead re-deposition data from periodic soil sampling and analysis conducted in Herculaneum by the U.S. Environmental Protection Agency (EPA). Since the report was completed, the DNR has periodically updated and refined its analysis of the EPA's re-deposition data upon receipt of new data. These statistical analyses of the re-deposition data indicate significant residential soil recontamination is occurring at unacceptable rates within 0.75 mile of Doe Run's Herculaneum smelter.

The DNR will continue to update its re-deposition data analysis as new data is received from the EPA. However, the re-deposition studies are now sufficiently complete for purposes of making decisions regarding the Herculaneum VPPP area according to the April 2002 Settlement Agreement between Doe Run, the DNR, and the Attorney General's Office (AGO). Paragraph 22 of the April 2002 Settlement Agreement states in pertinent part:

> "Following the purchase of a home, Doe Run shall leave the residence vacant until such time as either Doe Run demolishes the residence or the re-deposition studies, which will use monitoring that begins after June 1, 2002, are complete and the Department of Health and Senior Services, the DNR, the City [of Herculaneum] and Doe Run agree re-occupancy of a residence is not a risk to human health."

Based on our soil re-deposition data analyses, the DNR does not agree that general re-occupancy of residences in the Herculaneum VPPP area is protective of human health in the long-term without continued response actions. Under current conditions, on average, residential yards within one-quarter mile of the smelter would require additional clean-up in a little over two years, and would require continued remediation every 5 to 7 years, based on an action level of 400 mg/kg lead in soil. The frequency of clean up needed to continue the use of this area as residential is unsustainable and unacceptable to the DNR.

There are several other factors, in addition to soil re-contamination, that contribute to our decision on the outcome of these properties, including air monitoring data approaching and recently exceeding the National Ambient Air Quality Standard (NAAQS) for lead; elevated levels of lead in residential dust; continued elevated lead levels in road dust; the EPA's speciation and bioavailability data; and agency observations of company operations. We believe the weight of the current evidence indicates that residential re-use of properties within the VPPP area is ill advised.

Doe Run must proceed with demolishing all homes within the Herculaneum VPPP area pursuant to paragraph 22 of the Settlement Agreement. The demolition of homes must be conducted in compliance with all applicable federal, state, and local laws, regulations, and ordinances, and with all necessary permits and notifications.

In addition to our primary concerns regarding the health and well being of Herculaneum residents, the DNR is concerned about the effects of abandoning the VPPP area. In general, the DNR would be supportive of non-residential redevelopment of the Herculaneum VPPP area in a manner that is protective of public health and the environment. The new road and bridge projects should improve access to the Herculaneum VPPP area, which should in turn make this area attractive for non-residential redevelopment. The EPA has resources available to assist in developing non-residential reuse prospects for the Herculaneum VPPP area.

Obviously Doe Run's active participation is essential to any efforts to redevelop the Herculaneum VPPP area, since the company will own much of the land. We believe Doe Run's participation in such efforts will benefit the company and the Herculaneum community by promoting economic growth in the "old town" area. Such efforts by the company would be consistent with the contributions of Doe Run and its corporate predecessors to the development and growth of Herculaneum, and would help assure an overall positive legacy for the company in Herculaneum.

The DNR hopes that this letter will serve to further discussions with Doe Run and the other stakeholders, including the city of Herculaneum and interested residents regarding the future of the Herculaneum VPPP area, and the possibilities for viable non-residential reuse of this area.

If you have any questions, you may contact me at (573) 751-4732, or Mr. Robert Geller, Director, Hazardous Waste Program, at (573) 751-3176. We have also sent a letter to Mr. Dan Vornberg, of your staff, outlining in more detail other correlated issues pertaining to the VPPP area.

Sincerely,

DEPARTMENT OF NATURAL RESOURCES

Doyle Childers

Doyle Childers
Director

DC:rhl

c: Mr. Jeff Kendall, Mayor, City of Herculaneum
Mr. Aaron Miller, Doe Run
Mr. Dan Vornberg, Doe Run
Ms. Cecilia Tapia, U. S. EPA, Region VII
Mr. Joe Bindbeutel, Missouri Attorney General's Office
Mr. Larry O'Leary, Herculaneum Community Advisory Group
Mr. Scott Clardy, Missouri Department of Health and Senior Services

Matt Blunt, Governor • Doyle Childers, Director

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

www.dnr.mo.gov

DEC 23 2005

The Honorable Jeff Kendall
Mayor
City of Herculaneum
City Hall, 1 Parkwood Drive
Herculaneum, MO 63048

Dear Mayor Kendall:

We appreciate the opportunity to discuss lead contamination issues in Herculaneum and the future of the Herculaneum Voluntary Property Purchase Plan (VPPP) area at the September 26, 2005, Herculaneum Board of Aldermen meeting. We are writing in response to specific information requests made by the Board of Aldermen.

Based on currently available information, the Missouri Department of Natural Resources (DNR) believes that residential re-use of the Herculaneum VPPP area may pose future unacceptable risks to human health and the environment if current soil re-contamination rates are not reduced. We continue to observe upward trends in soil re-contamination monitoring data within 0.75 mile of the smelter. Based on our analyses of the soil re-contamination trends and other data, the current rates of lead re-deposition are highest in the VPPP area and unrestricted residential use will be unsafe in the VPPP area in the near future. If conditions at Doe Run's facility change, such that re-contamination is significantly reduced, the department would re-evaluate the suitability of the VPPP area for residential use.

We believe Doe Run should continue to demolish homes it owns in the Herculaneum VPPP area according to the April 2002 Settlement Agreement between the state and Doe Run. Although participation in the VPPP under the Settlement Agreement is voluntary, the DNR strongly recommends Doe Run and the city of Herculaneum continue to pursue efforts to relocate residents remaining in the VPPP area, and eventually vacate the remaining occupied homes. The DNR strongly supports efforts by Doe Run and the city to re-use the VPPP area for acceptable non-residential uses that are protective of public health and the environment now and into the future. Commercial, industrial, and recreational options for re-use of the VPPP area are all viable depending on the specifics of any potential redevelopment scenario. The DNR will be pleased to continue to work with the city, Doe Run, the U.S. Environmental Protection Agency (EPA), and other stakeholders on appropriate redevelopment of the Herculaneum VPPP area.

As you know, some eligible residents chose not to participate in the Herculaneum VPPP by not responding and requesting property appraisals or not accepting purchase offers from Doe Run. There are also a number of purchase offers made by Doe Run that have been accepted but are not closed. Since the property purchase program was voluntary, there is no mandatory obligation for VPPP area residents to participate or accept purchase offers and move under the April 2002 Settlement Agreement between the state and Doe Run. The DNR issued a few exceptions according to the Settlement Agreement allowing some elderly residents to continue renting Doe Run-owned homes in the VPPP area.

Therefore, a number of homes in the VPPP area will remain occupied for the time being, while the majority of homes are vacant. Homes that remain occupied within the VPPP area and homes outside of the VPPP area that become re-contaminated to levels that pose risks to human health will likely require additional cleanup through time. The DNR and the EPA, Region VII continue to work with Doe Run to further reduce releases from the facility and other processes. Additional controls to reduce releases may, in turn, reduce recontamination rates. Our goal is to reduce releases to a point where additional cleanup or other actions will not be required to protect human health and the environment.

Enclosed is a copy of a map showing the Herculaneum VPPP area, and the properties owned and not owned by Doe Run based on the best available current information. We will continue to work with Doe Run to obtain additional information regarding the ownership status of the properties in the VPPP area. Additional properties may come under Doe Run ownership as outstanding accepted purchase offers close. Also enclosed is a copy of the DNR's most recent report of its re-deposition data analysis. It is our understanding that the state Department of Health and Senior Services has also sent a similar letter in regard to the VPPP area.

We look forward to working with you, Doe Run, the EPA, your Master Planning Committee, and various other stakeholders to outline a reasonable path forward that remains protective of human health and the environment while promoting a viable economy for your community. We also look forward to being a participant in the collaborative planning process which E2 Inc. will facilitate to assist the city in identifying and evaluating re-use options for the VPPP area.

Please contact me at Missouri Department of Natural Resources, P.O. Box 176, Jefferson City MO 65102-0176 or by telephone at (573) 751-4732 if you have any questions.

Sincerely,

DEPARTMENT OF NATURAL RESOURCES

Doyle Childers

Doyle Childers
Director

DC:rhl

Enclosures

c: Mr. Daniel Vornberg, Doe Run Company
Mr. Jim Gulliford, U.S. EPA, Region VII
Mr. Gene Thompson, President, Herculaneum Today & Tomorrow
Mr. Larry O'Leary, Herculaneum Community Advisory Group

TAB 8

U.S. Environmental Protection Agency

Region 7

Serving Iowa, Kansas, Missouri, Nebraska and 9 Tribal Nations

Fact Sheet

November 2005

Herculaneum Lead Smelter Site - Herculaneum, Missouri

QUARTERLY UPDATES

The U.S. Environmental Protection Agency (EPA) Region 7 is initiating a quarterly newsletter directed to the Herculaneum community to keep you informed about progress at the Herculaneum Lead Smelter Site. This newsletter will include information about the work conducted by the EPA, the Missouri Department of Natural Resources (MDNR), and the Missouri Department of Health and Senior Services (MDHSS). The Herculaneum Community Advisory Group (CAG) will also use the newsletter to provide community members with information about their activities.

COMMUNITY ADVISORY GROUP MESSAGE

The following section was submitted by the CAG Core Team.

The Core Team of the Community Advisory Group is committed to the improvement of the City of Herculaneum. We want to continue to work with and support all elements of the City of Herculaneum—mainly the residents and property owners in their efforts to improve the City. We are creating a component of the Herculaneum Master Plan. We are enthusiastic about Herculaneum's future, and we believe that the City's progress depends on a number of factors. One of these is an informed citizenry.

Community Advisory Group Meeting

The next meeting of the Herculaneum Lead Smelter Community Advisory Group will be held:

Tuesday, November 15, 2005
7:00 p.m. - 8:30 p.m.
Herculaneum High School
Cafeteria
Herculaneum, Missouri

We will continue to provide you with factual information about the facts relevant to your health and the efforts to reduce and maintain reduced levels of lead contamination in our City. In order to remain informed, please come to our next meeting at 7 p.m. on November 15, 2005, at Herculaneum High School's cafeteria.

In addition to the progress that the City is making, there continue to be some troubling indicators about our physical environment. Doe Run has failed to keep its emissions in compliance with the standard for ambient air quality for the first two quarters of 2005. In addition, tests by EPA indicate that recontam-ination is *continuing to occur within eight-tenths of a mile of the Doe Run facility. The lead* levels of the road dust along the haul routes, including Main Street, continue to be elevated.

We are committed to the improvement of our City, and we want to continue our efforts by working with the agencies and other elements of our City. This includes our commitment to keeping our residents and property owners informed.

The CAG Core Team

Tim Meyers 636-475-3230
Greg Bieber 636-475-3441
Catherine Malugen 636-475-3665
Larry O'Leary 636-475-3310

YARD SOIL PROGRESS

EPA continued oversight of Doe Run's replacement of contaminated yard soils during calendar year 2005. To date, 407 yards have been replaced and 113 home interiors have been cleaned.

QUARTERLY MONITORNING

Monitoring for lead recontamination in surface soils is being conducted by EPA every three months. The data indicate that lead levels are trending upward in areas within eight-tenths of a mile from the smelter. Data and statistics collected by EPA are available on EPA website:
http://www.epa.gov/region7/cleanup/superfund/major_superfund_site_reports.html

SLAG PILE UPDATE

From March 23 through April 22, 2005, the public was invited to provide comments on an Engineering Evaluation/ Cost Analysis (EE/CA) Report for the Herculaneum Slag Storage Area. EPA and MDNR reviewed all comments submitted by the public and sent revised comments on the Wetland Mitigation Plan to Doe Run on May 3, 2005.

On October 5, 2005, EPA approved the Action Memorandum to initiate the approved response action for the slag pile. A large berm will be constructed around a portion of the pile to prevent off-site migration. The berm will also serve as a shield from flood waters. Copies of the approved EE/CA, all comments and related responses are available at the Herculaneum City Hall and the Windsor Branch of the Jefferson County Library.

NEW JOACHIM BRIDGE

Progress continues on the design for the new south bridge over Joachim Creek. Doe Run had asked EPA and MDNR to approve the use of lead smelter slag as a fill material for the new bridge and road base. The agencies approved this use of slag material but specified several environmental safeguards to secure the material and prevent potential exposure.

LEAD SPECIATION STUDY

In September 2004, EPA requested that the Laboratory for Environmental and

Geological Studies at the University of Colorado conduct a study to characterize soils and household dust collected from selected Herculaneum residences. EPA has approved the final report of this study. The study concludes that most of the lead found in samples is derived from smelter activity. A copy of the speciation report is available for viewing with other site documents at the Herculaneum City Hall.

BIOAVAILABILITY STUDY

EPA has also approved an EPA-financed University of Missouri School of Veterinary Medicine bioavailability study. The bioavailability study was conducted to determine how easily the lead from soils and dust collected from selected Herculaneum residences is absorbed in the bodies of your children.

Some forms of lead are more easily absorbed and present a greater danger of lead poisoning in children. Juvenile swine were used in the study because these animals are considered a good model for gastrointestinal absorption in children. The study confirmed that the bioavailability of lead found in house dust was below EPA default values and above EPA default values in yard soils and that both posed a significant threat to public health if cleanup actions were not undertaken for those homes and yards above the action levels. A copy of the bioavailability study is available for viewing with other site documents at the Herculaneum City Hall.

AMBIENT AIR QUALITY VIOLATIONS

During the first and second quarters of 2005, air emissions from the Doe Run Herculaneum smelter exceeded the National Ambient Air Quality Standards (NAAQS) for lead. Doe Run has received a Notice of Violation from the State's Air Pollution Control Program (APCP) related to these violations.

VOLUNTARY PROPERTY PURCHASE PROGRAM

As of September 13, 2005, 126 property purchases have been closed and 141 purchase offers have been accepted by Herculaneum residents.

ADDITIONAL INFORMATION

EPA encourages the community to review the Administrative Record file, which is available at the following locations:

Herculaneum City Hall
1 Parkwood Court
Herculaneum, Missouri

EPA Region 7
901 N. 5th Street
Kansas City, Kansas

If you have questions or need additional information, please contact:

Dianna Whitaker
Office of External Programs
U.S. EPA Region 7
901 N. 5th Street
Kansas City, KS 66101
whitaker.dianna@epa.gov
Phone: 913-551-7003 or
Toll Free: 1-800-223-0425

TAB 9

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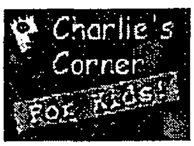


Fact Sheet

March 2005

Administrative Record & Engineering Evaluation/Cost Analysis Report Released for Public Comment, Herculaneum Lead Smelter Site, Herculaneum, Missouri

INTRODUCTION

EPA Region 7 and the Missouri Department of Natural Resources invite the public to comment on the Engineering Evaluation/Cost Analysis Report for the Herculaneum Slag Storage Area at the Herculaneum Lead Smelter Site in Herculaneum, Missouri. On Jan. 19, 2005, the Missouri Department of Natural Resources approved the draft Engineering Evaluation/Cost Analysis Report submitted by The Doe Run Company. EPA had previously approved the report. The public comment period will begin March 23, 2005, and end April 22, 2005.

How to Submit Your Comments

Please submit your written comments on the report to:
Dianna Whitaker
Office of External Programs
U.S. EPA Region 7
901 N. Fifth St.
Kansas City, Kan. 66101
Phone: 913-551-7003 or
Toll free: 800-223-0425
Written comments will be accepted from March 23 to April 22, 2005.

How to Learn More

For Whom:	Herculaneum community and other interested persons
When:	March 30, 2005, 7 p.m. to 9 p.m.
Where:	Senn-Thomas Middle School, 200 Senn-Thomas Drive in Herculaneum
Who:	EPA, Missouri Department of Natural Resources and Doe Run will be available to answer questions.

SLAG PILE CLEANUP PLAN

The Engineering Evaluation/Cost Analysis Report is a document that evaluates the human health and environmental impacts of the smelter's slag pile. The report compares several alternatives for mitigation and recommends one alternative for implementation. The recommended response action for the slag pile consists of building a large berm around a portion of the pile to prevent off-site migration. The berm will also serve as a shield from flood waters. The action includes capturing and treating storm water runoff from the pile.

PUBLIC MEETING

EPA will hold a public meeting so that community members can learn about the slag pile report. Representatives from EPA, Missouri Department of Natural Resources and Doe Run will be available to answer questions on March 30, 2005, from 7 p.m. to 9 p.m. at the Senn-Thomas Middle School in Herculaneum.

YARD SOIL CLEANUP

EPA continues to oversee the replacement of lead-contaminated yard soil and interior home cleaning conducted by Doe Run. Approximately 340 yards have been completed, and an additional 60 residences are scheduled for this year.

QUARTERLY MONITORING

Monitoring for redeposition of lead in surface soils is being conducted by EPA every three months. The data is indicating that lead levels are trending upward in areas within a half mile of the smelter. EPA is conducting a study to determine the source (s) of the lead and will continue the quarterly monitoring program. Completion of the study is anticipated this summer.

SLAG PILE REPORT AND ADMINISTRATIVE RECORD

EPA encourages the community to review the administrative record. The administrative record is the official record for the site and contains site reports including the Engineering Evaluation/Cost Analysis. The public is invited to submit comments on the slag pile report and on the entire administrative record. Comments should be submitted by April 22, 2005. The administrative record is available at the following locations during normal business hours:

Herculaneum City Hall
1 Parkwood Court
Herculaneum, Mo.

EPA Region 7
901 N. Fifth St.
Kansas City, Kan.

EPA and Missouri Department of Natural Resources will review and respond to all comments and will determine appropriate changes to the slag pile response action as a result of public comments. Requests for additional information should be addressed to:

Dianna Whitaker
Office of External Programs
EPA Region 7
901 N. Fifth St.
Kansas City, KS 66101
Phone: 913-551-7003
Toll free: 1-800-223-0425

whitaker.dianna@epa.gov

TAB 10

LEAD SOIL TREND ANALYSIS
THROUGH MAY, 2006
EVALUATION BY INDIVIDUAL QUADRANT
Herculaneum Lead Smelter Site
Herculaneum, Missouri

Analysis 2006

Tetra Tech EM Inc. (Tetra Tech) was tasked by the U.S. Environmental Protection Agency (EPA) Region 7 Enforcement/Fund Lead Removal program to conduct a trend analysis of soil lead concentrations at selected locations within Herculaneum, Missouri (City). Specifically, the Tetra Tech Superfund Technical Assessment and Response Team (START) 3 was requested to review and analyze data that would enable EPA to determine if soil lead concentrations were increasing over time at a variety of locations within the City. Two tasks were identified: 1) perform a trend analysis for individual quadrants within each yard using the most current sampling data, and 2) estimate the range of monthly increase in lead concentrations for properties grouped into three categories based on distance from the smelter (less than or equal to 0.25 mile, 0.25 to 0.50 miles, and 0.50 to 0.75 miles). The assessment was conducted under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and the Superfund Amendments and Reauthorization Act of 1986. The project was assigned under START Contract No. EP-06-01, Task Order No. 0021.

Tetra Tech focused its analysis on one data set called "Recontamination." This data set includes results from a number of residential properties. The data were collected from four different quadrants at each property, and additional data for several properties came from samples collected in driveway areas outside the quadrants. Lead sampling was conducted at each location at varying intervals from the time removal activities were completed in early 2002 (sampling round 6). Sampling was conducted monthly prior to 2003, quarterly from 2003 to 2004, and semi-annually after October 2005 (sampling round 22). This report includes results for sampling conducted between August 2002 (sampling round 7) and May 2006 (sampling round 23). Due to the sequence of removal activities, not all properties underwent the same number of sampling events; the number of events ranged from 4 to 17 events per quadrant for individual properties. At many locations, some intervals within the series were omitted because of weather or access restrictions. The lead concentrations were determined by use of a portable X-ray fluorescence (XRF) instrument. Samples were collected and analyzed in accordance with the quality assurance project plan (QAPP) dated September 11, 2001.

This document presents the methods used to evaluate changes in soil lead concentrations following the removal activities, and the results of this analysis.

Methods

Trend tests were conducted for each property using data collected from round 7 (August 2002) through round 23 (May 2006). The non-parametric Mann-Kendall test was used to evaluate temporal trends for each sampled quadrant at the individual properties. The Mann-Kendall test is a widely used statistical test for detecting monotonic trends (that is, trends that are either increasing or decreasing) in time-series of data (Gilbert 1987; Helsel and Hirsch 1992; Gibbons 1994). Because the Mann-Kendall test uses only the relative magnitude of the data rather than their measured values, it has a number of desirable properties: the data need not be normally distributed; and the test is not significantly affected by outliers, missing data, or censored data. Censored data are treated in the Mann-Kendall test by setting all non-detect values to a concentration slightly below the minimum detected concentration. It should be noted that a minimum of four sampling events are required to perform this test, so properties with fewer than four rounds of sampling were not evaluated. Properties which were not sampled during round 23 were also excluded from the trend analysis.

For all properties where at least one quadrant showed a significant increasing trend based on the Mann-Kendall test, regression analysis was performed to estimate the monthly increase in lead concentration. This analysis was performed to provide rough estimates of the range of potential increase in lead concentrations for properties grouped according to distance from the smelter. Three distance categories were evaluated: less than or equal to 0.25 miles, 0.25 to 0.50 miles, and 0.50 to 0.75 miles. Because the purpose of this analysis was to only provide rough estimates of the rate of change in lead concentration, regression was performed on the data in original units (i.e., untransformed data). It should be noted that certain evaluation methods and diagnostic tools that are commonly used in linear regression analysis (e.g., evaluation of different transformations of the data, verification of model assumptions, and evaluation of outliers) were not used in this analysis.

For quadrants with detected data only, ordinary least squares (OLS) linear regression analysis was used. For quadrants with one or more censored (nondetect or ND) measurements, a censored maximum likelihood estimation (MLE) approach was used, following Helsel (2005). Censored MLE methods are increasingly being used in environmental assessment work, given the increased speed of modern personal computers and the enhanced capabilities that have been added into many commercial statistical software packages. As described in Helsel (2005), MLE regression techniques can be implemented using commercial software with capabilities for performing parametric survival analysis on interval-censored data. It should be noted that MLE regression for left-censored data is also referred to as "Tobit analysis" in the technical literature. MLE methods recognize each censored datum as an interval, bounded by zero at the lower limit and the detection or reporting limit at the upper limit. Application of OLS regression with censored data is contraindicated, as it requires substitution of an assumed value (typically zero, the detection limit, or one half the detection limit) for each censored datum, resulting in biased estimates for the regression parameters.

Results

Temporal trends in lead concentrations for 17 properties are summarized in Table 1 and Figure 1. The trend analysis identified 14 out of 17 properties where at least one quadrant showed a statistically significant increasing trend. No statistically significant decreasing trends were identified for any properties. Seven properties had increasing lead concentrations in all four quadrants: house numbers 5, 9, 18, 19, 20, 22, and 24. Two properties had increasing lead concentrations in three of four quadrants: house numbers 6 and 16. Four properties had increasing lead concentrations in two of four quadrants: house numbers 3, 7, 76 (only two quadrants evaluated), and 101. House number 15 had only one quadrant with an increasing trend in lead concentration. Three properties, house numbers 102, 103, and 104, showed no statistically significant trend in lead concentrations in any quadrant. All trend results are depicted graphically in Figure 1. Open symbols are used in Figure 1 to represent censored (nondetect) data, and solid symbols represent detected data.

Trend results reported for soil lead concentrations through sampling round 23 were similar to those reported during the last quarterly period, with the following exceptions. A single quadrant from each of four properties that did not show a significant trend in lead concentration from rounds 7 through 22, now show a statistically significant increase in lead concentration with the addition of the data from round 23. The properties include house numbers 6 (quadrant 4), 15 (quadrant 4), 24 (quadrant 1), and 101 (quadrant 3). Quadrant 4 from house number 102 showed a significant increasing trend in lead concentration from rounds 7 through 22, but this trend is no longer significant with the addition of data from round 23. Two additional properties, house numbers 103 and 104, now have 4 rounds of sampling and are being evaluated for the first time using the Mann-Kendall trend test. No significant increase in lead concentration was seen for any of the quadrants for these two properties.

The results of OLS and MLE regression analysis performed on properties that showed a significant increasing trend in lead concentration in at least one quadrant are provided in Table 2. The slope, intercept, standard error of the slope, and two-sided 95 percent confidence intervals for the slope estimates were calculated for 41 quadrants within 13 properties. Ranges for the monthly rates of increase in lead were 1.11 to 8.25 milligrams (mg)/month, 1.25 to 4.71 mg/month, and 0.78 to 7.80 mg/month, respectively, for properties located less than or equal to 0.25 miles, 0.25 to 0.50 miles, and 0.50 to 0.75 miles from the smelter. The upper 95 percent confidence limit (UCL) for the monthly rate of increase was also evaluated to estimate maximum potential rates of increase. Because of the variability in the individual estimates, the 50^{th}, 75^{th}, and 90^{th} percentiles of the distribution of the individual UCLs within each distance category are also reported in Table 2. The 75^{th} and 90^{th} (in parentheses) percentile values for the monthly rate of increase for the properties grouped according to increasing distance from the smelter are 6.85 (10.85), 5.35 (6.19), and 3.88 (12.25) mg/month. It should be cautioned that these are considered rough estimates only, as no attempt was made to evaluate the validity of the regression model assumptions, or the uncertainty associated with the predicted rates of increase.

References:

Gibbons, R. D. 1994. *Statistical Methods for Groundwater Monitoring.* John Wiley & Sons, Inc. New York, New York.

Gilbert, R. O. 1987. *Statistical Methods in Environmental Pollution Monitoring.* John Wiley & Sons, Inc. New York, New York.

Helsel, D. 2005. *Nondetects and Data Analysis: Statistics for Censored Environmental Data.* John Wiley & Sons, Inc., New York, NY. 250 p.

Helsel, D. R. and R. M. Hirsh. 1992. *Statistical Methods in Water Resources.* Elsevier. New York, New York.

TABLE 1

RESULTS FO STATISTICAL TESTING FOR MONOTONIC TRENDS (MANN-KENDALL TEST) IN LEAD CONCENTRATON
INDIVIDUAL QUADARNS FOR SAMPLING ROUNDS 7 THROUGH 23
HERCULANEUM LEAD SMELTER SITE - HERCULANEUM, MISSOURI

Distance From Smelter (miles)1	House Number	Quadrant	Number of Sampling Events2	Number of Detected Samples	Sampling Event		Mann-Kendall Test Statistic3 (S)	Probability > S	Trend Significant?4 (Yes/No)	Direction of Trend
					First	Last				
0.10	76	Q1	10	10	10/30/2003	05/18/2006	29	0.005	Yes	Increasing
		Q2	10	10	10/30/2003	05/18/2006	25	0.014	Yes	Increasing
0.20	20	Q1	16	16	08/26/2002	05/01/2006	74	0.001	Yes	Increasing
		Q2	16	16	08/26/2002	05/01/2006	72	0.001	Yes	Increasing
		Q3	16	16	08/26/2002	05/01/2006	84	<0.001	Yes	Increasing
		Q4	16	16	08/26/2002	05/01/2006	82	<0.001	Yes	Increasing
	101	Q1	9	9	12/22/2003	05/02/2006	12	0.130	No	N/A
		Q2	9	8	12/22/2003	05/02/2006	16	0.060	No	N/A
		Q3	9	9	12/22/2003	05/02/2006	20	0.022	Yes	Increasing
		Q4	9	9	12/22/2003	05/02/2006	22	0.012	Yes	Increasing
	102	Q1	9	9	12/22/2003	05/02/2006	14	0.090	No	N/A
		Q2	9	9	12/22/2003	05/02/2006	-8	0.238	No	N/A
		Q3	9	9	12/22/2003	05/02/2006	14	0.090	No	N/A
		Q4	9	9	12/22/2003	05/02/2006	12	0.130	No	N/A
0.25	5	Q1	16	13	08/26/2002	05/02/2006	88	<0.001	Yes	Increasing
		Q2	16	15	08/26/2002	05/02/2006	92	<0.001	Yes	Increasing
		Q3	16	16	08/26/2002	05/02/2006	85	<0.001	Yes	Increasing
		Q4	16	16	08/26/2002	05/02/2006	74	0.001	Yes	Increasing
	6	Q1	16	16	08/23/2002	05/02/2006	42	0.036	Yes	Increasing
		Q2	16	16	08/23/2002	05/02/2006	72	0.001	Yes	Increasing
		Q3	16	16	08/23/2002	05/02/2006	15	0.163	No	N/A
		Q4	16	16	08/23/2002	05/02/2006	46	0.026	Yes	Increasing
	22	Q1	15	15	08/26/2002	05/02/2006	51	0.009	Yes	Increasing
		Q2	15	15	08/26/2002	05/02/2006	53	0.007	Yes	Increasing
		Q3	15	15	08/26/2002	05/02/2006	58	0.004	Yes	Increasing
		Q4	15	15	08/26/2002	05/02/2006	57	0.004	Yes	Increasing
	24	Q1	13	13	11/07/2002	05/02/2006	30	0.042	Yes	Increasing
		Q2	13	13	11/07/2002	05/02/2006	56	0.001	Yes	Increasing
		Q3	13	13	11/07/2002	05/02/2006	40	0.012	Yes	Increasing
		Q4	13	12	11/07/2002	05/02/2006	43	0.007	Yes	Increasing
0.50	15	Q1	6	5	09/16/2002	05/02/2006	7	0.136	No	N/A
		Q2	6	6	09/16/2002	05/02/2006	8	0.102	No	N/A
		Q3	6	5	09/16/2002	05/02/2006	6	0.186	No	N/A
		Q4	6	5	09/16/2002	05/02/2006	11	0.028	Yes	Increasing
	16	Q1	14	10	09/16/2002	05/01/2006	27	0.071	No	N/A
		Q2	14	8	09/16/2002	05/01/2006	63	<0.001	Yes	Increasing
		Q3	14	8	09/16/2002	05/01/2006	44	0.010	Yes	Increasing
		Q4	14	10	09/16/2002	05/01/2006	59	0.001	Yes	Increasing
	19	Q1	16	15	08/22/2002	05/01/2006	51	0.016	Yes	Increasing
		Q2	16	13	08/22/2002	05/01/2006	53	0.013	Yes	Increasing
		Q3	16	13	08/22/2002	05/01/2006	51	0.016	Yes	Increasing
		Q4	16	15	08/22/2002	05/01/2006	66	0.003	Yes	Increasing

TABLE 1

RESULTS FO STATISTICAL TESTING FOR MONOTONIC TRENDS (MANN-KENDALL TEST) IN LEAD CONCENTRATON INDIVIDUAL QUADARNS FOR SAMPLING ROUNDS 7 THROUGH 23 HERCULANEUM LEAD SMELTER SITE - HERCULANEUM, MISSOURI

Distance From Smelter (miles)1	House Number	Quadrant	Number of Sampling Events2	Number of Detected Samples	Sampling Event		Mann-Kendall Test Statistic3 (S)	Probability > S	Trend Significant?4 (Yes/No)	Direction of Trend
					First	Last				
0.54	9	Q1	16	16	08/22/2002	05/01/2006	61	0.005	Yes	Increasing
		Q2	16	16	08/22/2002	05/01/2006	65	0.003	Yes	Increasing
		Q3	16	16	08/22/2002	05/01/2006	64	0.004	Yes	Increasing
		Q4	16	15	08/22/2002	05/01/2006	67	0.002	Yes	Increasing
0.60	18	Q1	17	17	08/23/2002	05/02/2006	56	0.015	Yes	Increasing
		Q2	17	16	08/23/2002	05/02/2006	47	0.033	Yes	Increasing
		Q3	17	17	08/23/2002	05/02/2006	65	0.006	Yes	Increasing
		Q4	17	17	08/23/2002	05/02/2006	72	0.003	Yes	Increasing
0.75	3	Q1	17	14	08/23/2002	05/02/2006	15	0.169	No	N/A
		Q2	17	15	08/23/2002	05/02/2006	66	0.005	Yes	Increasing
		Q3	17	16	08/23/2002	05/02/2006	33	0.084	No	N/A
		Q4	17	16	08/23/2002	05/02/2006	81	0.001	Yes	Increasing
0.79	103	Q1	4	1	03/28/2005	05/02/2006	3	0.271	No	N/A
		Q2	4	1	03/28/2005	05/02/2006	-1	0.500	No	N/A
		Q3	4	1	03/28/2005	05/02/2006	1	0.500	No	N/A
		Q4	4	2	03/28/2005	05/02/2006	3	0.271	No	N/A
0.80	7	Q1	17	17	08/23/2002	05/02/2006	21	0.142	No	N/A
		Q2	17	15	08/23/2002	05/02/2006	71	0.003	Yes	Increasing
		Q3	17	13	08/23/2002	05/02/2006	40	0.054	No	N/A
		Q4	17	12	08/23/2002	05/02/2006	60	0.010	Yes	Increasing
1.00	104	Q1	4	2	03/28/2005	05/01/2006	-3	0.271	No	N/A
		Q2	4	2	03/28/2005	05/01/2006	0	0.625	No	N/A
		Q4	4	1	03/28/2005	05/01/2006	-3	0.271	No	N/A

Notes:

1 Properties are ordered as a function of increasing distance from the smelter.
2 Trend tests were not conducted for properties with fewer than four rounds of sampling, or for properties not sampled during round 23.
3All censored (nondetect) measurements were set equal to a concentration slightly lower than the minimum detected value.
4 Monotonic trends are significant for probabilities less than or equal to 0.05; significant negative values for the

Mann-Kendall test statistic indicate that trends are decreasing; and significant positive values for the
Mann-Kendall test statistic indicate that trends are increasing.
NA No significant trend identified.

TABLE 2

RESULTS OF LINEAR REGRESSION ANALYSIS FOR ALL QUADRANTS SHOWING A SIGNIFICANT INCREASING MANN-KENDALL TREND TEST RESULT

Distance From Smelter (miles)	House Number	Quadrant	Number of Sampling Events	Regression Coefficients for Days Versus Concentration			Monthly Increase (mg/kg-month)	95 Percent Confidence Limits for Monthly Increase in Lead Concentrations		Percentiles for the Distribution of Estimated UCLs within Each Distance Group		
				Intercept	Slope	S.E. (Slope)		LCL	UCL	50	75	90
Less than or Equal to 0.25	76	Q1	10	45.78	0.16	0.05	4.68	1.24	8.12	5.28	6.85	10.85
	76	Q2	10	68.18	0.13	0.10	3.82	-2.94	10.59			
	20	Q1	16	94.89	0.13	0.03	3.99	1.90	6.09			
	20	Q2	16	55.84	0.27	0.05	8.01	4.73	11.29			
	20	Q3	16	111.47	0.17	0.04	5.12	2.76	7.48			
	20	Q4	16	82.13	0.28	0.04	8.25	5.48	11.02			
	101	Q3	9	11.92	0.12	0.04	3.46	0.94	5.97			
	101	Q4	9	-4.14	0.13	0.04	3.97	1.18	6.75			
	5	Q1	16	30.34	0.11	0.02	3.41	2.26	4.57			
	5	Q2	16	30.45	0.12	0.02	3.64	2.53	4.75			
	5	Q3	16	65.90	0.11	0.02	3.30	2.00	4.61			
	5	Q4	16	67.62	0.16	0.03	4.75	2.65	6.85			
	6	Q1	16	124.37	0.04	0.04	1.24	-1.24	3.73			
	6	Q2	16	83.85	0.11	0.03	3.41	1.54	5.28			
	6	Q4	16	80.12	0.04	0.02	1.11	-0.30	2.53			
	22	Q1	15	85.76	0.10	0.03	2.96	1.24	4.68			
	22	Q2	15	180.78	0.12	0.03	3.55	1.43	5.66			
	22	Q3	15	73.28	0.08	0.03	2.52	0.89	4.16			
	22	Q4	15	72.14	0.09	0.03	2.77	0.94	4.60			
	24	Q1	13	135.26	0.05	0.03	1.58	-0.29	3.44			
	24	Q2	13	27.08	0.14	0.03	4.30	2.61	5.99			
	24	Q3	13	64.01	0.04	0.01	1.14	0.43	1.84			
	24	Q4	13	60.04	0.07	0.02	1.97	0.53	3.42			
0.25 to 0.50	15	Q4	6	53.44	0.05	0.01	1.42	0.89	1.96	2.65	5.35	6.19
	16	Q2	14	28.52	0.16	0.02	4.71	3.33	6.09			
	16	Q3	14	61.74	0.04	0.02	1.33	0.29	2.36			
	16	Q4	14	58.91	0.14	0.03	4.24	2.30	6.19			
	19	Q1	16	55.13	0.04	0.01	1.28	0.44	2.13			
	19	Q2	16	41.67	0.06	0.01	1.94	1.04	2.84			
	19	Q3	16	40.91	0.04	0.02	1.25	0.04	2.46			
	19	Q4	16	55.63	0.07	0.02	2.04	0.94	3.13			
0.50 to 0.75	9	Q1	16	69.44	0.04	0.01	1.18	0.22	2.13	2.41	3.88	12.25
	9	Q2	16	64.23	0.08	0.02	2.48	1.23	3.73			
	9	Q3	16	93.17	0.26	0.08	7.80	2.48	13.13			
	9	Q4	16	86.85	0.10	0.02	2.97	1.63	4.31			
	18	Q1	17	73.60	0.05	0.02	1.40	0.31	2.49			
	18	Q2	17	52.84	0.05	0.02	1.57	0.54	2.60			
	18	Q3	17	71.84	0.03	0.01	0.78	0.18	1.37			
	18	Q4	17	59.49	0.05	0.01	1.62	0.90	2.34			
	3	Q2	17	51.56	0.04	0.01	1.34	0.41	2.27			
	3	Q4	17	45.22	0.04	0.01	1.32	0.71	1.92			

Notes:

LCL Lower confidence limit
MLE Maximum likelihood estimation
ND Nondetect
OLS Ordinary least squares
S.E. Standard error of estimate
UCL Upper confidence limit

OLS regression was used for cases where all results were detected. Censored MLE regression was used in all cases where one or more measurements were reported as below the detection limit (that is, "ND") following Helsel (2005). All analyses were performed on the data in original units.

Helsel, D. 2005. Nondetects and Data Analysis: Statistics for Censored Environmental Data. John Wiley & Sons, Inc., New York, NY. 250 pages.

FIGURE 1. Lead Concentration Trends From Round 7 Through 23

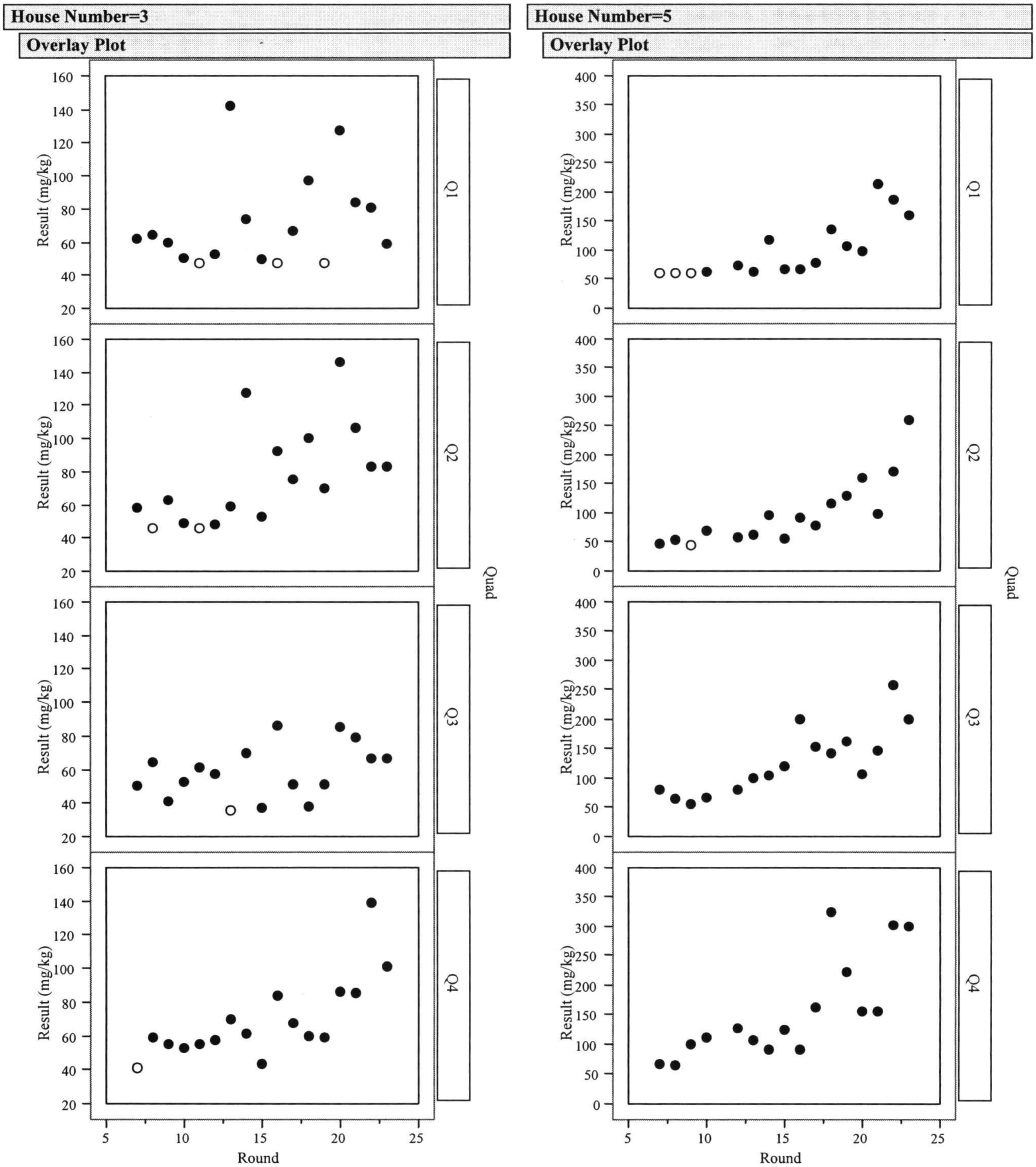


FIGURE 1. Lead Concentration Trends From Round 7 Through 23 (Cont)

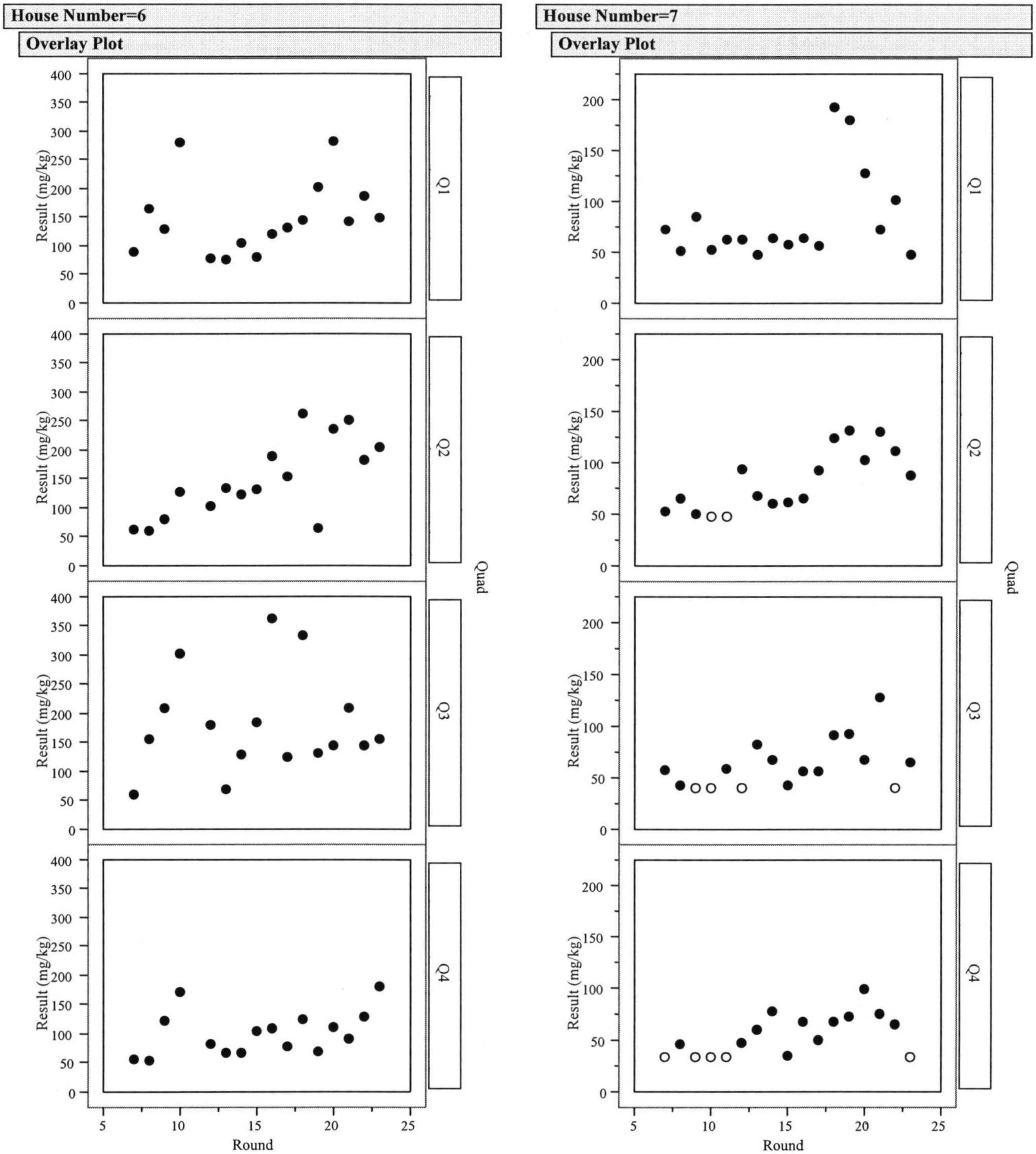


FIGURE 1. Lead Concentration Trends From Round 7 Through 23 (Cont)

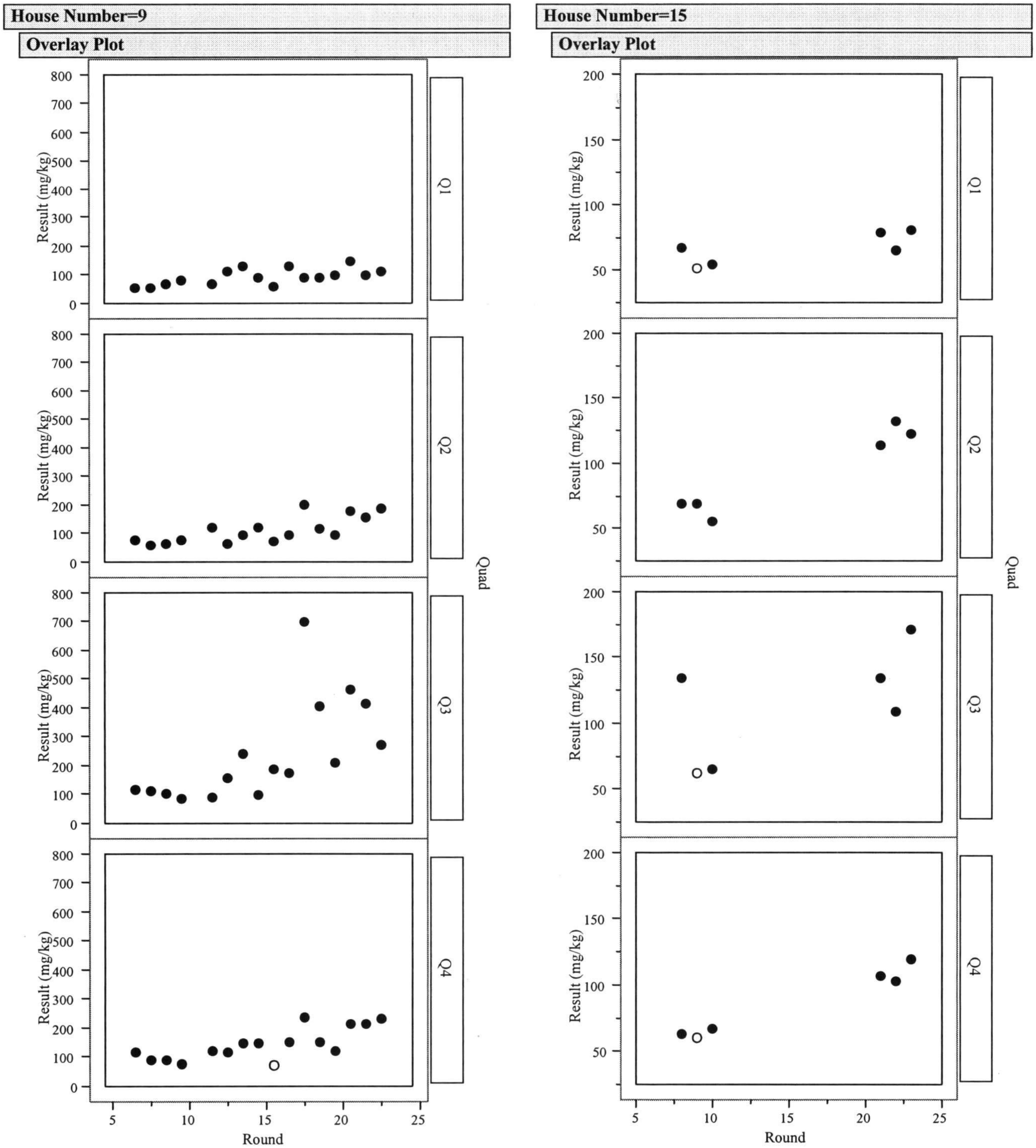


FIGURE 1. Lead Concentration Trends From Round 7 Through 23 (Cont)

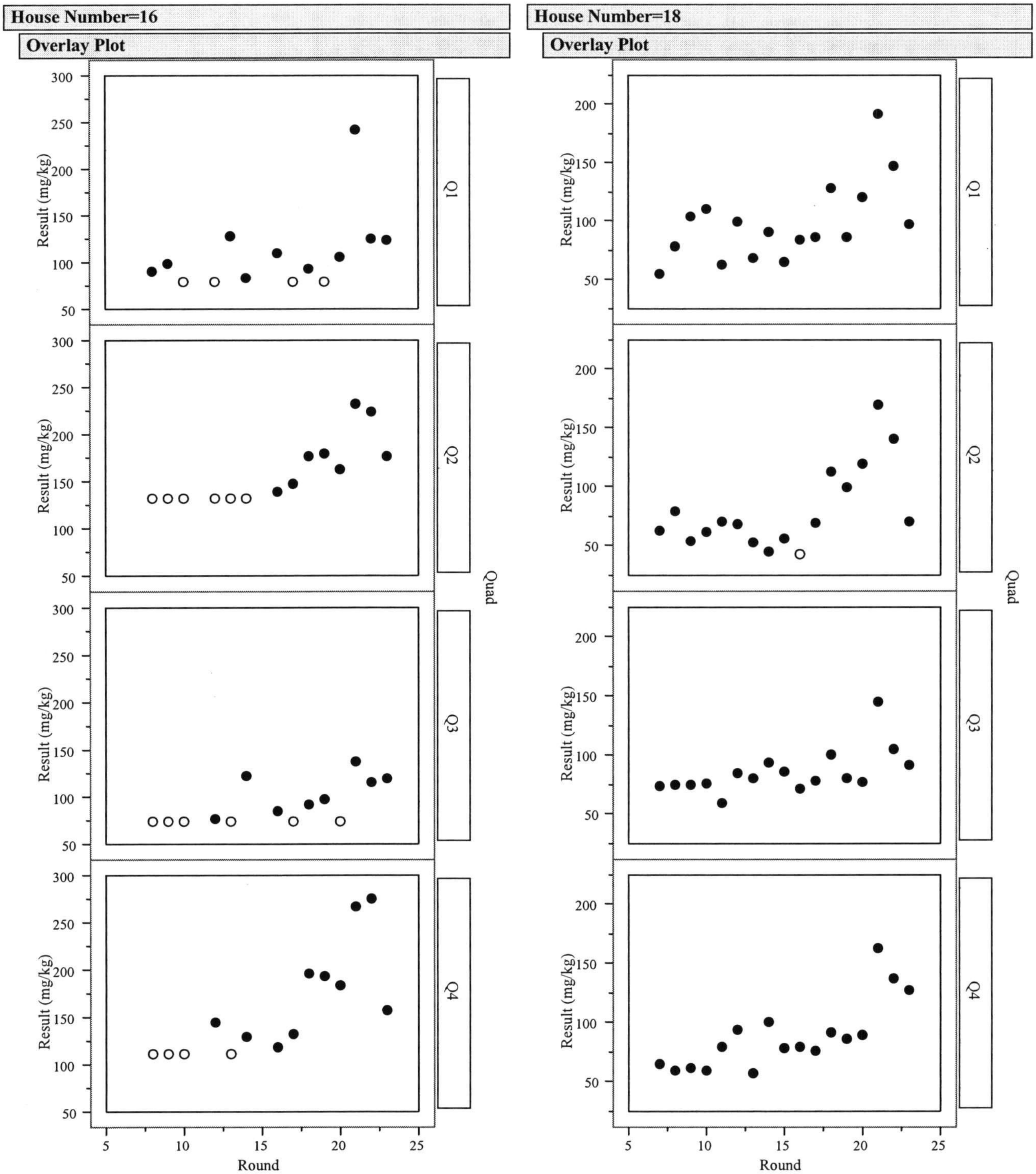
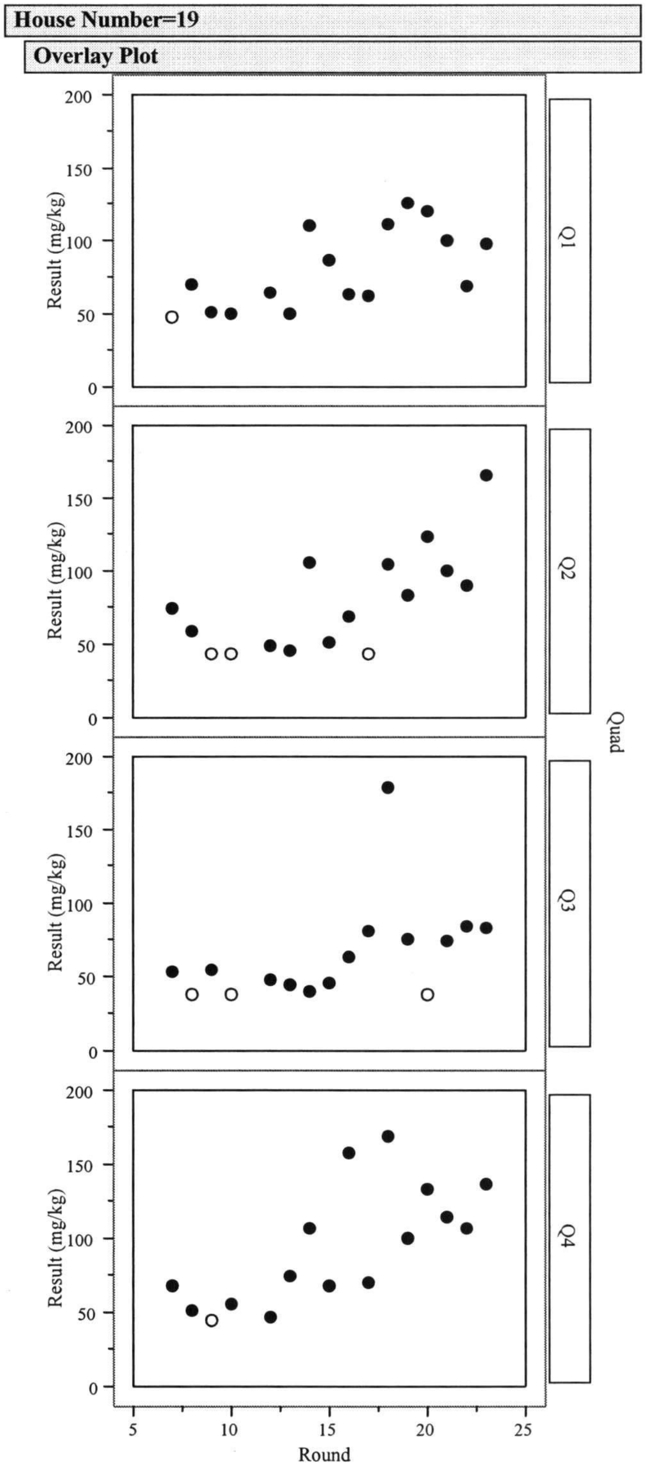


FIGURE 1. Lead Concentration Trends From Round 7 Through 23 (Cont)



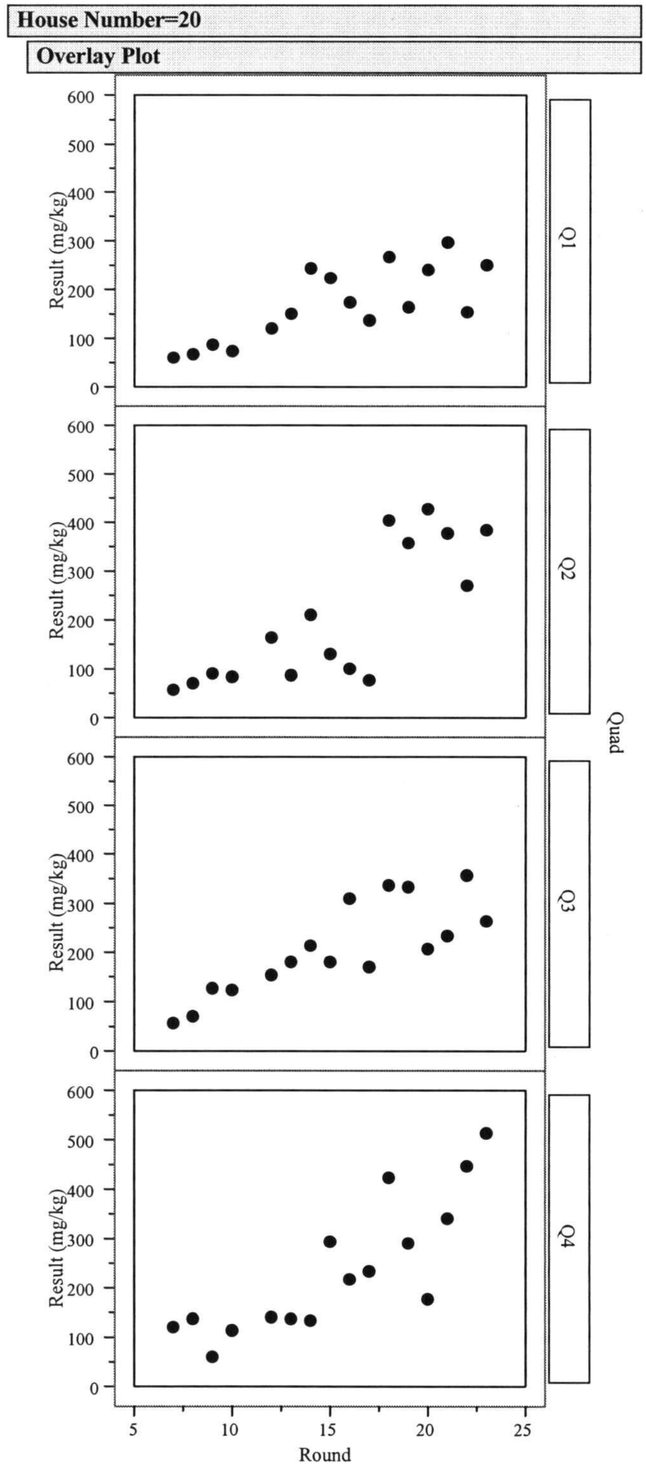
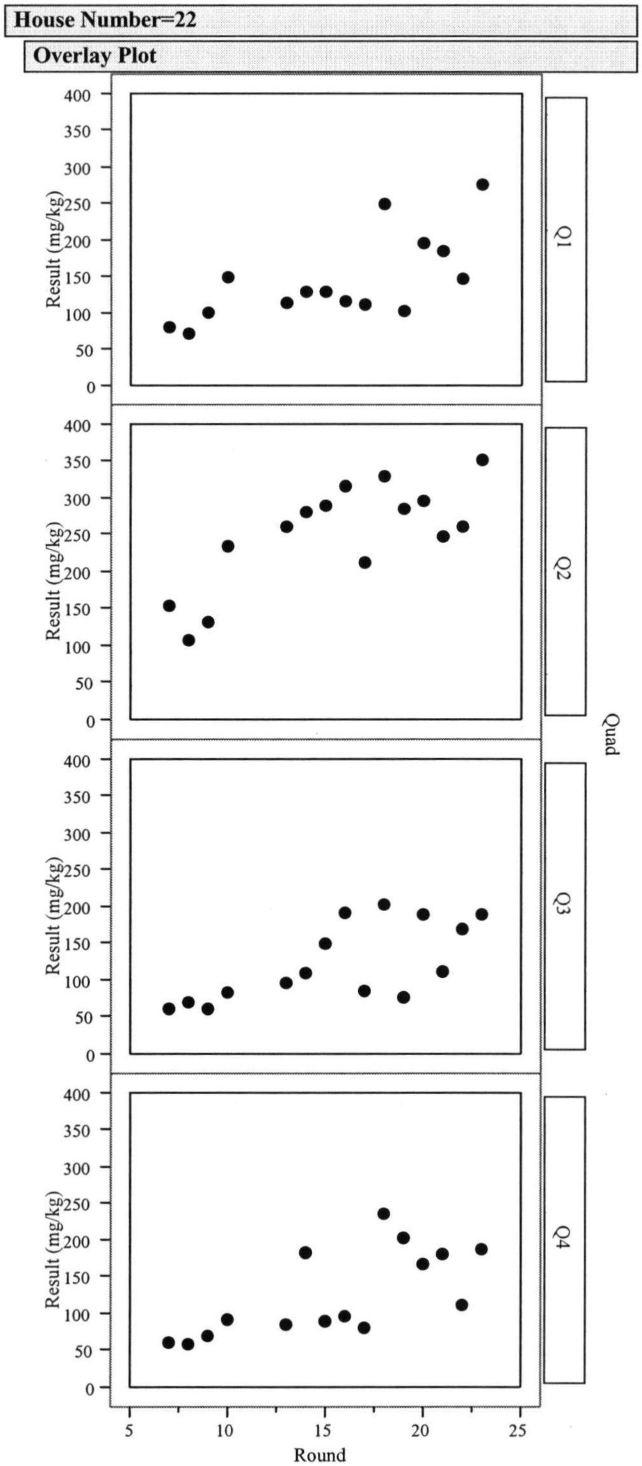


FIGURE 1. Lead Concentration Trends From Round 7 Through 23 (Cont)



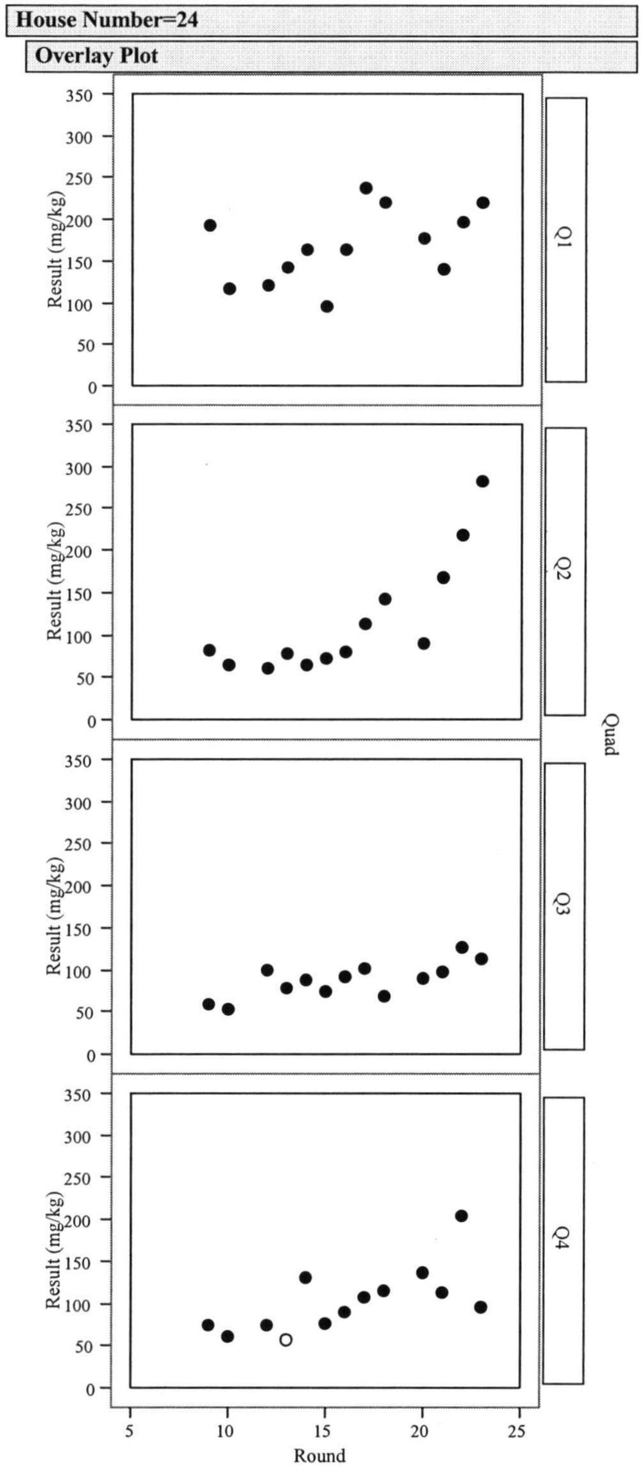
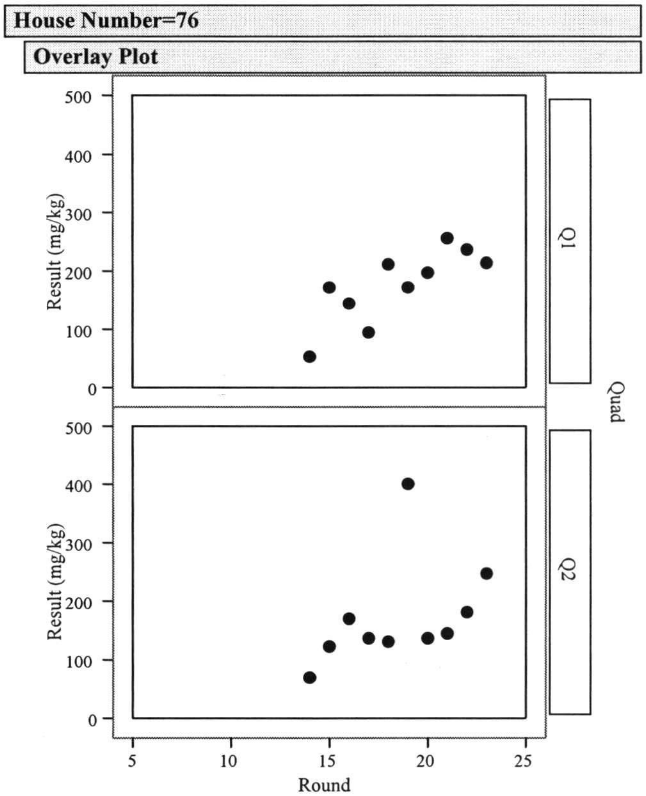


FIGURE 1. Lead Concentration Trends From Round 7 Through 23 (Cont)



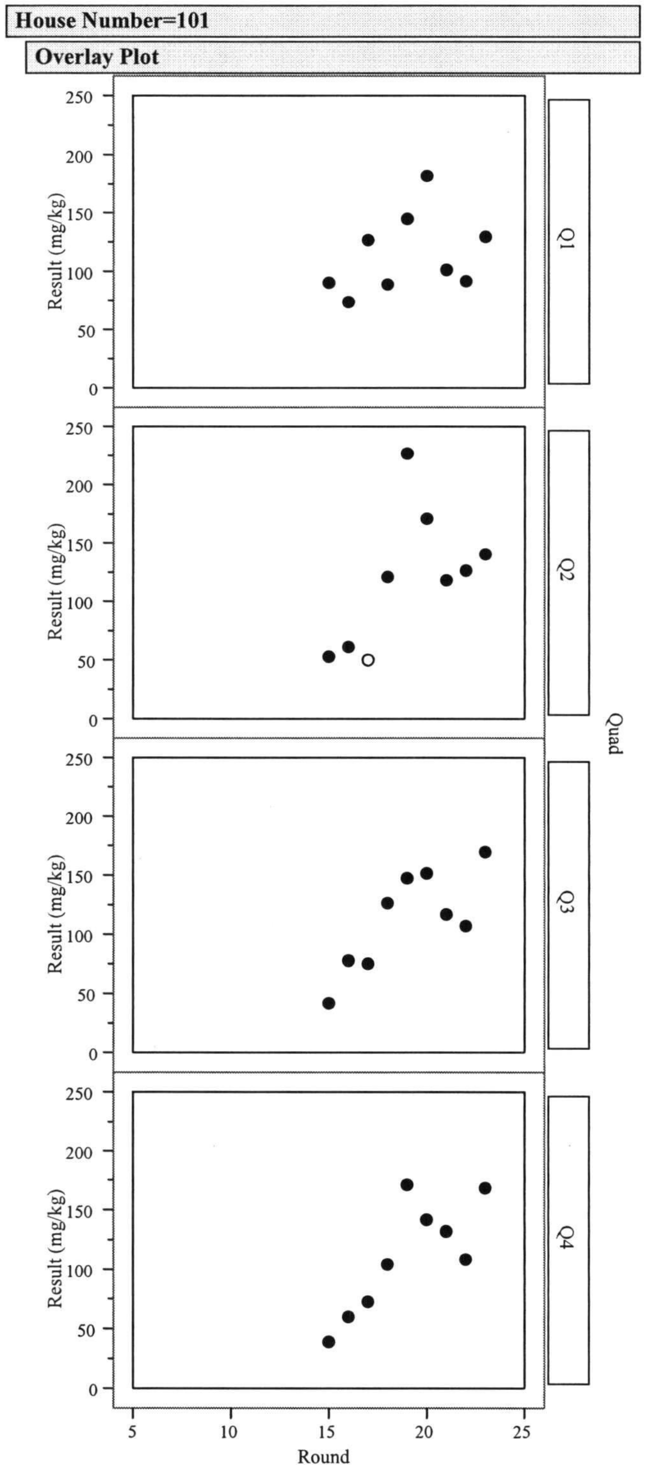
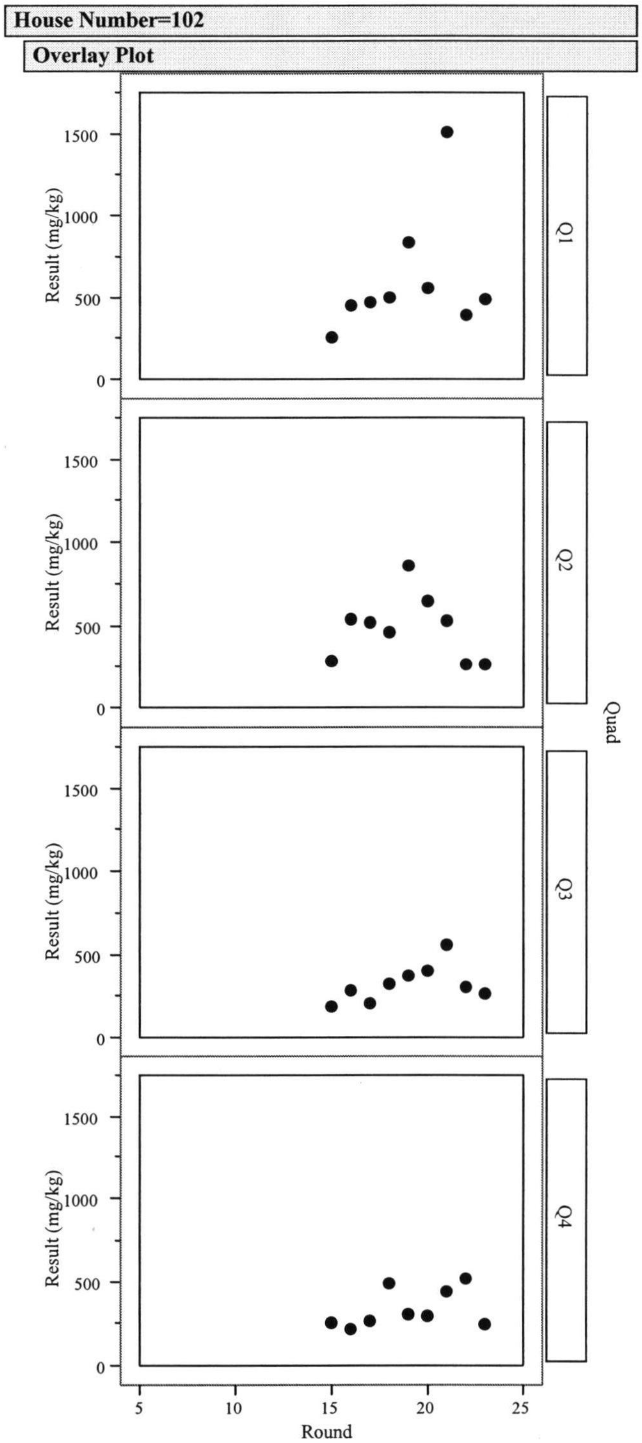


FIGURE 1. Lead Concentration Trends From Round 7 Through 23 (Cont)



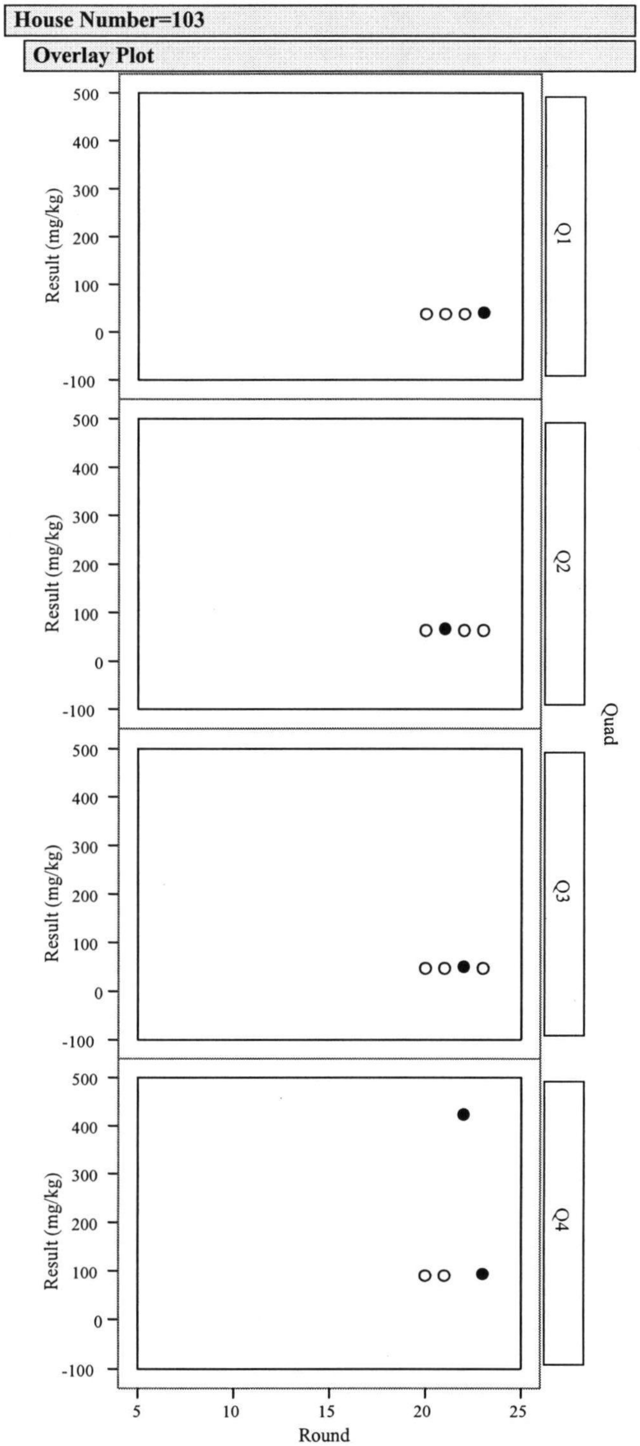
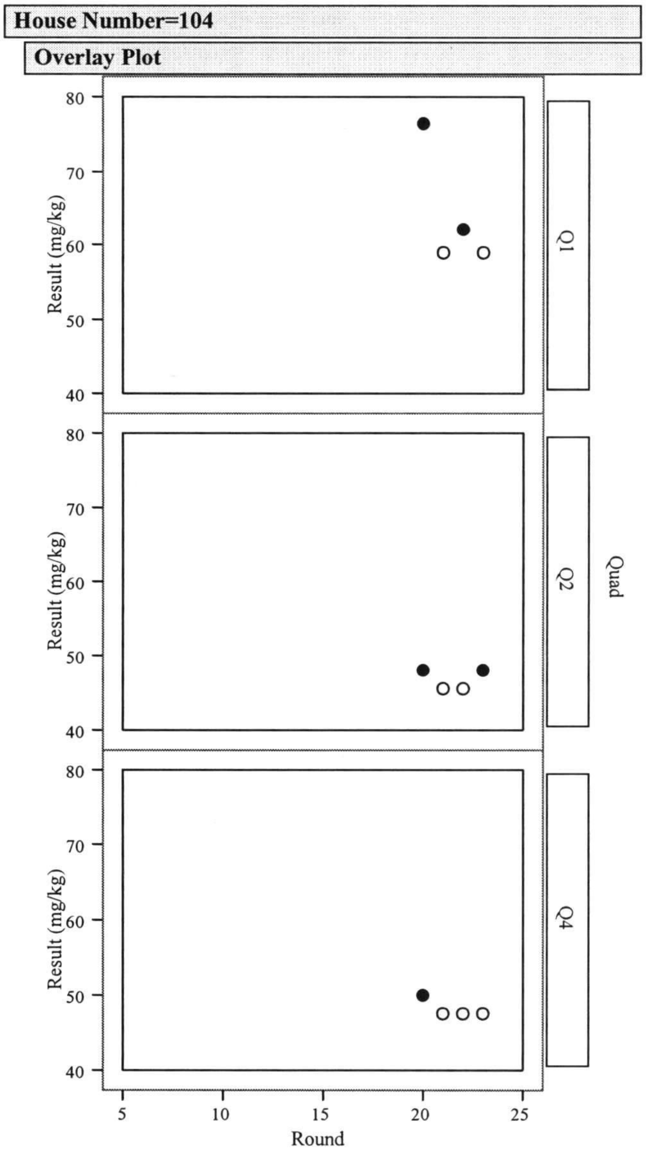


FIGURE 1. Lead Concentration Trends From Round 7 Through 23 (Cont)



~~TAB 3~~

TETRA TECH

September 20, 2007

Mr. Roy Crossland
START Project Officer
U.S. Environmental Protection Agency, Region 7
901 North 5th Street
Kansas City, Kansas 66101

Subject: **Comparison of Lead Concentrations in the Top 1 Inch of Soil to Concentrations Measured in Surface Scrape Samples**
Herculaneum Lead Smelter, Herculaneum, Missouri
U.S. EPA Region 7 START 3, Contract No. EP-06-01, Task Order No. 0021
Task Monitor: Bruce Morrison, On-Scene Coordinator

Analysis 2007

Dear Mr. Crossland:

Tetra Tech EM Inc. is submitting the attached Comparison of Lead Concentrations in the Top 1 Inch of Soil to Concentrations Measured in Surface Scrape Samples for the Herculaneum Lead Smelter. Using data provided by U.S. Environmental Protection Agency (EPA) from the site, Tetra Tech conducted a statistical analysis of the data to determine if lead concentrations in paired samples of the top 1 inch of soil differ significantly from those of scrape samples. Lead concentrations in the scrape samples were found significantly higher than those in the 1-inch samples.

If you have any questions or comments, please contact the project manager at (816) 412-1762.

Sincerely,

David Homer, PhD
Project Manager

Ted Faile, PG
START Program Manager

cc: Bruce Morrison, EPA
Ray Bienert, Tetra Tech

Enclosures

Tetra Tech EM Inc.
415 Oak Street, Kansas City, MO 64106
Tel 816.412.1741 Fax 816.410.1748 www.tetratech.com

X9004.06.0021.000

COMPARISON OF LEAD CONCENTRATIONS IN THE TOP 1 INCH OF SOIL TO CONCENTRATIONS MEASURED IN SURFACE SCRAPE SAMPLES

HERCULANEUM LEAD SMELTER
HERCULANEUM, MISSOURI

CERCLIS ID: MOD006266373

Superfund Technical Assessment and Response Team (START) 3 Contract
Contract No. EP-S7-06-01, Task Order 0021

Prepared For:

U.S. Environmental Protection Agency
Region 7
Superfund Division
901 North 5th Street
Kansas City, Kansas 66101

September 20, 2007

Prepared By:

Tetra Tech EM Inc.
415 Oak Street
Kansas City, Missouri 64106
816-412-1741

X9004.06.0021.000

INTRODUCTION

Tetra Tech EM Inc. (Tetra Tech) was tasked by the U.S. Environmental Protection Agency (EPA) Region 7 Enforcement/Fund Lead Removal program to compare, statistically, lead concentrations collected from the top 1 inch of soil with lead concentrations in surface scrape samples at selected locations within Herculaneum, Missouri (City). Specifically, EPA requested the Tetra Tech Superfund Technical Assessment and Response Team (START) to determine whether concentrations of lead were statistically significantly higher (or lower) in data sets comprised of samples collected within the top 1 inch of soil versus scrape samples from the soil surface. The assessment was conducted under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and the Superfund Amendments and Reauthorization Act of 1986. The project was assigned under START Contract No. 68-S7-01-41, Task Order No. 0021.

Tetra Tech conducted this analysis using the data set called "Sanitized 7003 AOC Results." The data used for this analysis consisted of matched pairs of analytical results from each depth interval for the following groups of locations: quadrant samples from individual properties (Q1, Q2, Q3, and Q4), haul route (HR) samples, and samples from play areas (PA). No matched results were available for samples collected from gravel drives (GD) or gardens (GAR). The analysis was conducted for both the full data set (293 matched pairs) and a modified data set (266 matched pairs). The modified data set excluded the following samples with higher levels of historical contamination that were judged inconsistent with recent surface recontamination trends: EPA ID Numbers 54, 56, 148, 301 (quadrants 3 and 4 only), 485, 551, and 566. The two data sets will hereafter be referred to as the "full" and "reduced" data sets.

The statistical approach and results from this analysis are presented below. Section 1.0 provides a more formal and detailed description of the statistical methods used, while Section 2.0 provides a general description considered more suitable for presentation to audiences without a formal background in statistics.

STATISTICAL METHODS, RESULTS, AND CONCLUSIONS (Formal Presentation)

Lead results for samples collected from the top 1 inch and surface scrapings of soil were analyzed using Version 5 of the JMP® statistical software package from SAS® Institute. Because samples were collected from two depths at the same set of physical locations, the results were amenable to analysis using a matched-pairs statistical design. Statistical comparisons were conducted using both parametric (paired-difference *t* test, which assumes the paired differences between the two populations being compared follow a normal distribution) and nonparametric (Wilcoxon signed-rank test, which assumes that the distribution of paired differences is symmetrical about the median) tests. Results were evaluated at the 5 percent ($p \leq 0.05$) level of significance (i.e., equivalent to a 95 percent confidence level). Additional details of the statistical tests are provided in EPA (2006), as well as in mainstream statistical texts (Zar 1999).

Results of the statistical comparison for the full and reduced data sets are presented in Figures 1 and 2, respectively. Figures 1 and 2 provide several graphical presentations of the data, as well as results of the formal statistical tests. Interpretation of the statistical output in Figures 1 and 2 depends on the question addressed in the test or, stated more formally, on the specific form of the null (H_0) and alternative hypotheses (H_A). For comparing measures of central tendency, one can just ask whether the mean (or median) difference in the pair-wise concentrations in the two depth intervals is equal to zero. This is stated as a two-sided hypothesis, and the form of H_0 and H_A are shown below:

<u>Two-sided test</u> – H_0: the mean (median) difference in the pair-wise results for the 1-inch and scrape samples is equal to zero

H_A: the mean (median) difference in the pair-wise results for the 1-inch and scrape samples is not equal to zero

For the two-sided test, there is interest only in whether the mean (median) difference is zero. This is mathematically equivalent to testing whether the mean concentrations are different, but is more appropriately defined as the mean difference within the context of the paired-difference test. If H_0 is rejected, then it is concluded that the mean (median) difference is not equal to zero, but there is no interest in further investigating which of the two groups of samples has the higher (or lower) mean (or median) concentration.

The parametric test results for both the full data set ($n= 293$, $p= 0.06$, Figure 1) and reduced data set ($n= 266$, $p= 0.23$, Figure 2) indicate that the mean differences in lead concentration are not statistically different from zero (i.e., mean concentrations in the 1-inch and surface scrape samples are not statistically different). The nonparametric test result also indicates that the median difference in concentrations is not significantly different from zero for the full data set ($n= 293$, $p= 0.09$, Figure 1). However, the nonparametric test result for the reduced data set

($n= 266$, $p= 0.001$, Figure 2) indicates that the median difference in concentrations is significantly different from zero.

In order to resolve this contradictory finding for the two-sided parametric and nonparametric tests for the reduced data set, it is necessary to: (1) evaluate the assumptions of the paired-difference *t* test to determine if parametric testing is appropriate, and (2) recognize the different nature of the two tests (i.e., test of mean versus median difference in concentrations). A primary assumption of the parametric test is that the pair-wise differences in concentrations across all locations are normally distributed. This was tested using the Shapiro-Wilk W test at the 5-percent level of significance. The results of the Shapiro-Wilk W test are provided in Figures 1 and 2, and show that at the 95 percent confidence level, the paired differences in concentration are not normally distributed. The parametric test is considered to be robust to moderate departures from the assumption of normality, but is not robust to the presence of outliers (i.e., extreme differences in concentration). Therefore, results of the nonparametric Wilcoxon signed-rank test were judged to be more appropriate for comparing differences in concentration.

It is important to understand the subtle differences between the parametric and nonparametric tests. The parametric test evaluates the mean difference in concentrations, and is affected by extreme differences in concentration between the 1-inch and scrape results at each sampling location (e.g., differences were as large as 9,757 milligrams per kilogram [mg/kg] and 2,151 mg/kg, respectively, in the full and reduced data sets). The nonparametric test calculates the absolute value of the paired differences at each location, and then ranks the differences from smallest to largest. The median (mid-point for the ranked differences) difference in concentrations is evaluated in the nonparametric test, and this measure is relatively insensitive to the extreme differences in concentration that can confound interpretation of the parametric tests.

If there is interest beforehand in knowing the direction of any potential difference in concentration between the 1-inch and scrape samples, then a one-sided test is the more appropriate form. The hypotheses tested for the one-sided test are stated as follows:

<u>One-sided test</u> – H_0: the mean (median) difference in concentration between the 1-inch and scrape samples is less than or equal to zero

H_A: the mean (median) difference in concentration between the 1-inch and scrape samples is greater than zero

For the same significance (or confidence) level, the one-sided hypothesis test is said to have greater power compared to the two-sided test, which is a measure of the probability or likelihood that H_0 will be rejected when false. Because the assumptions of the parametric tests were not met (see discussion for the two-tailed test), only the results for the nonparametric tests are discussed below.

For the nonparametric comparisons, use of the one-sided hypothesis test lead to rejection of H_0 for both the full (n= 293, p= 0.045, Figure 1) and reduced (n= 266, p<0.001, Figure 2) data sets, leading to the conclusion that the median concentration (i.e., based on measurement of the median difference in all pair-wise concentrations) of lead is higher in the scrape samples for both data sets.

APPROACH, RESULTS, AND CONCLUSIONS (General Presentation)

Lead results for samples in the full (n= 293) and reduced (n= 266) data sets collected from the top 1 inch of soil and from surface scrapings of soil were compared using graphical and statistical methods.

Figure 3 presents plots of the differences in concentration (1-inch result minus result for scrape sample) for all pairs of measurements in the full (top panel) and reduced (bottom panel) data sets. Positive differences shown in the plots in Figure 3 indicate that the 1-inch results are higher than the results for the scrape sample, while negative differences indicate that the results for the scrape samples are higher.

For the full data set, a total of 128 out of 293 or 44 percent of the results were higher in the 1-inch interval, with a maximum difference of 9,757 mg/kg. A total of 163 out of 293 or 56 percent of the results (two results were the same in both intervals) were higher in the surface scrape samples, with a maximum difference of 1,557 mg/kg. The average difference measured across all 293 samples was 90 mg/kg (on average, results from the 1-inch interval were 90 mg/kg higher than results for the scrape samples), but the median difference was -7 mg/kg (indicating that the median concentration was higher in the scrape samples).

For the reduced data set, a total of 108 out of 266 or 41 percent of the results were higher in the 1-inch interval, with a maximum difference of 2,151 mg/kg. A total of 155 out of 266 or 58 percent of the results (three results were the same in both intervals) were higher in the surface scrape samples, with a maximum difference of 1,557 mg/kg. The average difference measured across all 266 pairs of samples was -24 mg/kg (on average, results from the scrape samples were 24 mg/kg higher than results for the 1-inch samples), and the median difference was -14 mg/kg.

Results for the 1-inch and scrape samples from both data sets were compared using statistical tests appropriate when data represent a series of matched pairs (i.e., a result is available for both the 1-inch interval and from a surface scraping for all locations). The goal of the tests was to determine whether, on average, the reported results in the 1-inch samples were higher (or lower) than the results for samples collected from surface scrapings. Both parametric and nonparametric statistical tests were conducted to determine if the average difference across all pairs of results was significantly different from zero (an average difference of zero would indicate no difference between the 1-inch and scrape results). It was determined that a key assumption for the parametric tests (that the distribution of all pair-wise differences in concentration follow a normal or Gaussian distribution) was not met in either the full or reduced data set and, therefore, that the nonparametric test results were more appropriate. The nonparametric test examines whether the median difference in concentrations (mid-point of the ranked or ordered concentration differences) is equal to zero, and does not assume that the differences follow a normal distribution.

The test results indicated with 95 percent confidence that, on average, lead concentrations were higher in the scrape samples for both the full (n= 293) and reduced (n= 266) data sets. This conclusion was based on testing whether the median (rather than the mean) difference in concentration across all pair-wise results was statistically different from zero.

REFERENCES

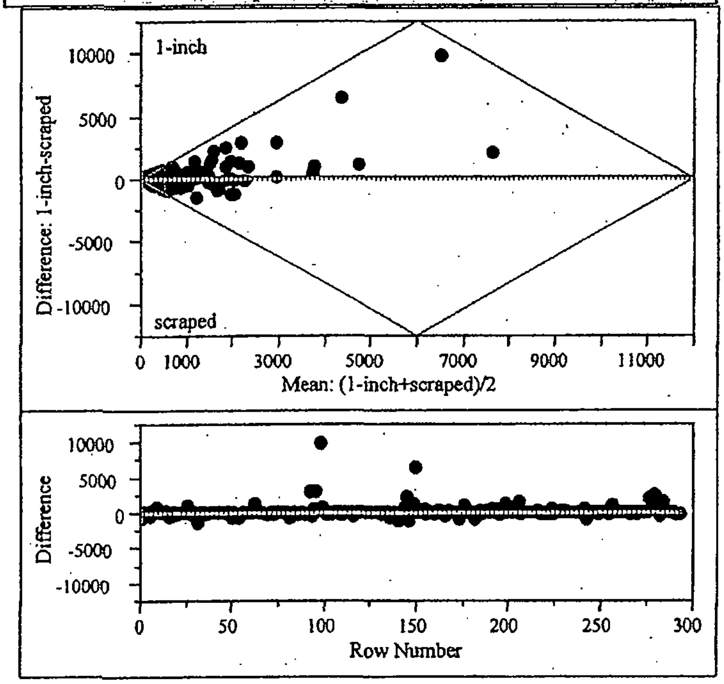
U.S. Environmental Protection Agency (EPA). 2006. "Data Quality Assessment: Statistical Methods for Practitioners, EPA QA/G-9R," EPA/240/B-06/003. Office of Environmental Information, Washington, DC. February.

Zar, J. H. 1999. *Biostatistical Analysis*, 4th Edition. Prentice-Hall, Inc. Upper Saddle River, NJ. 931 pp.

Figure 1 **Results of Matched-Pairs Statistical Analysis Comparing Lead Concentrations Measured in 293 1-Inch Soil and Surface Scrape Samples**

Matched Pairs (7003 AOC Results)

Difference: 1-inch-scraped



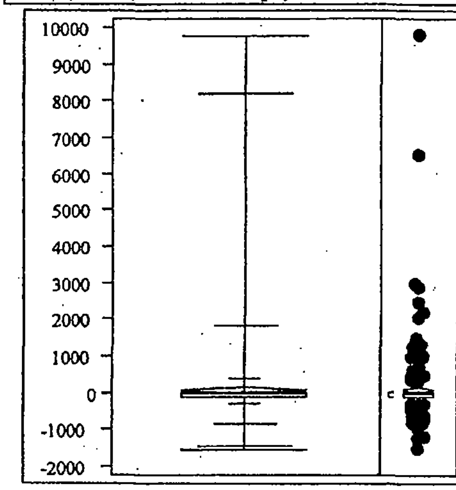
1-inch	569.166	t-Ratio	1.860302
scraped	478.804	DF	292
Mean Difference	90.3621	Prob > |t|	0.0638
Std Error	48.5739	Prob > t	0.0319
Upper95%	185.961	Prob < t	0.9681
Lower95%	-5.2372		
N	293		
Correlation	0.72026		

Wilcoxon Sign-Rank

	1-inch-scraped
Test Statistic	-2423.5
Prob > |z|	0.090
Prob > z	0.955
Prob < z	0.045

Distributions

Difference (1-inch - scrape)



Quantiles

100.0%	maximum	9757
99.5%		8212
97.5%		1843
90.0%		411
75.0%	quartile	46
50.0%	median	-7
25.0%	quartile	-97
10.0%		-274
2.5%		-855
0.5%		-1425
0.0%	minimum	-1557

Test of Whether the Paired Differences are Normally Distributed

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	Mu	90.3621	-5.237	185.9614
Dispersion	Sigma	831.4511	769.139	904.8349

Goodness-of-Fit Test

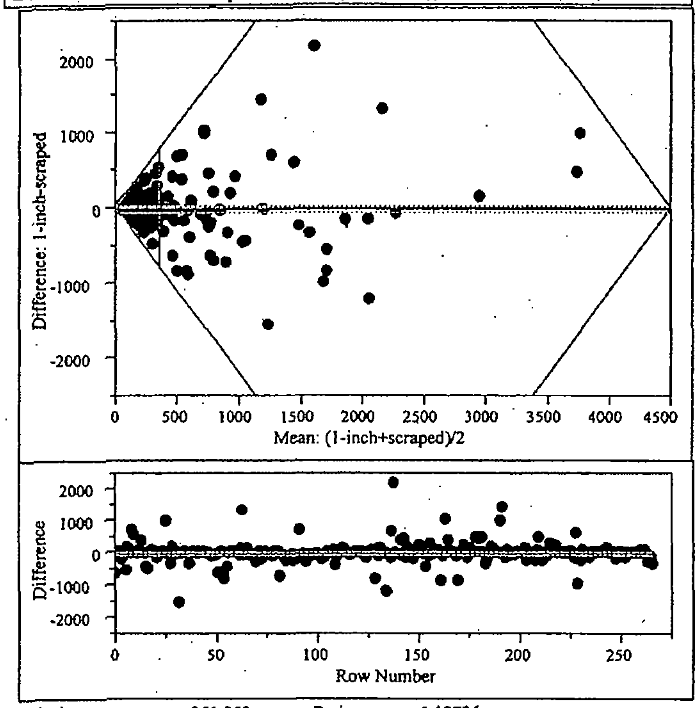
Shapiro-Wilk W Test

W	Prob<W
0.415988	0.0000

Figure 2 Results of Matched-Pairs Statistical Analysis Comparing Lead Concentrations Measured in 266 1-Inch Soil and Surface Scrape Samples

Matched Pairs (7003 AOC Results)

Difference: 1-inch-scraped



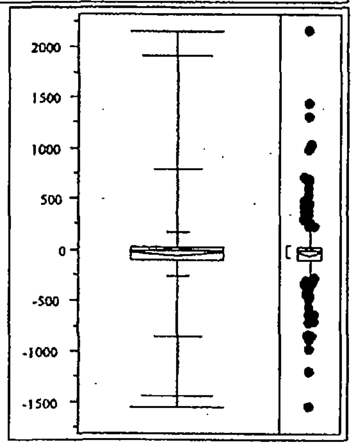
1-inch	351.359	t-Ratio	-1.19736
scraped	375.445	DF	265
Mean Difference	-24.086	Prob > |t|	0.2322
Std Error	20.116	Prob > t	0.8839
Upper95%	15.5215	Prob < t	0.1161
Lower95%	-63.694		
N	266		
Correlation	0.82596		

Wilcoxon Sign-Rank

	1-inch-scraped
Test Statistic	-4164.5
Prob > |z|	0.001
Prob > z	1.000
Prob < z	0.000

Distributions

Difference (1-inch - scrape)



Quantiles

100.0%	maximum	2151
99.5%		1908
97.5%		783
90.0%		163
75.0%	quartile	24
50.0%	median	-14
25.0%	quartile	-101
10.0%		-256
2.5%		-852
0.5%		-1441
0.0%	minimum	-1557

Test of Whether the Paired Differences are Normally Distributed

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	Mu	-24.086	-63.694	15.5215
Dispersion	Sigma	328.083	302.370	358.6115

Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.744382	0.0000

Figure 3 **Summary of Differences in Lead Concentrations Measured in Samples Collected from the Top 1 Inch of Soil and From Surface Scrapings of Soil for the Full (n= 293) and Reduced (n= 266) Data Sets**